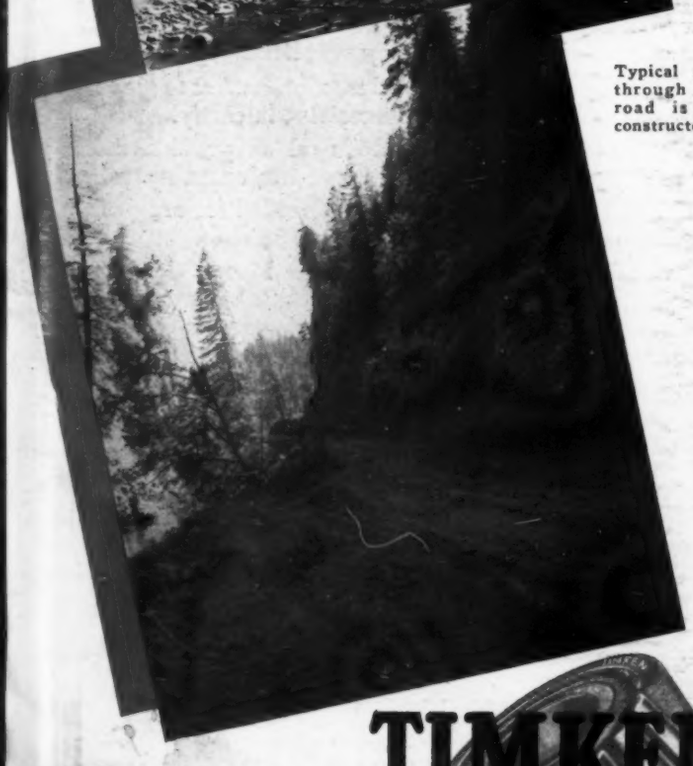
ROADS AND STREETS

JUNE 1945

Typical country through which road is being constructed.



Partly finished road-bed.

SPECTACULAR LOGGING ROAD JOB A TRIBUTE TO *Timken Rock Bits*

Up in the big timber country of Oregon a group of major logging operators are engaged in a joint project involving the construction of 48 miles of private logging road to open up new timber territory estimated to contain billions of feet of fir and hemlock.

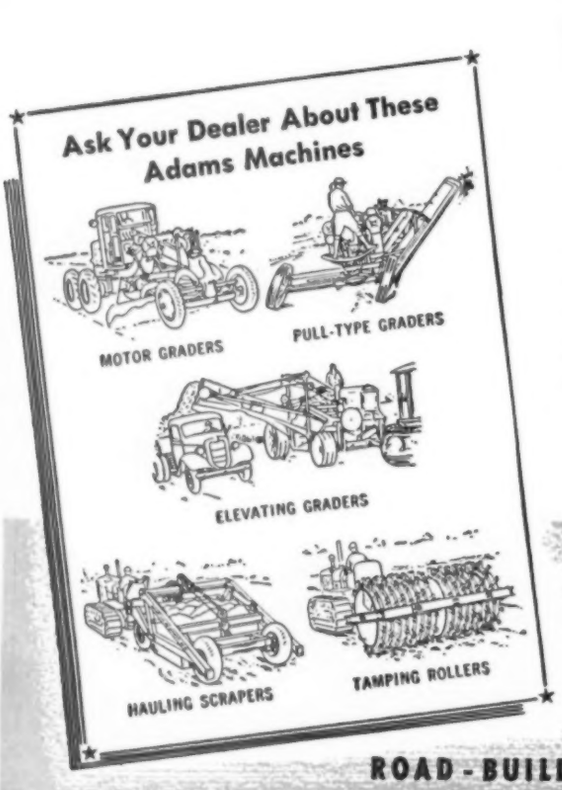
The road is being driven through virgin forests and for considerable distances literally has to be cut out of solid rock. One such stretch—8 miles long—is being constructed by Strong & McDonald, well-known northwest contractor, at an estimated cost of $384,000. The photographs reproduced here were taken in this sector.

Timken Rock Bits are used for all drilling, the rock encountered being an extremely hard metamorphic sandstone. One of the drill runners said it was the consistently hardest rock he had come up against in his 25 years of experience.

In spite of the difficult conditions however, Neil R. Miller, superintendent for Strong & McDonald, reports he is satisfied that Timken Rock Bits are helping to keep drilling costs down to a minimum. He also states that he is getting good service from Timken Bits reconditioned in a Timken Authorized Bit Service Shop in Portland.

If you are not using Timken Bits you are passing up opportunities for savings on every job you do. Write for address of nearest Authorized Distributor. The Timken Roller Bearing Company, Canton 6, Ohio.

Speed Road-Mix Operations with ADAMS MOTOR GRADERS



★ THREE IMPORTANT FEATURES combine to make Adams Heavy-Duty Motor Graders outstanding favorites for all types of road-mix work—scarifying, mixing, spreading:

1. The abundance of power and traction it takes to move large windrows of heavy materials . . . easily!
2. 8 overlapping forward speeds which provide the proper speed for fast mixing action in any material.
3. The positive, rigid blade control needed for uniform spreading, insuring smooth surface finishes.

You'll find husky, high-speed Adams Motor Graders ideal for all manner of surface, ditch and bank work—providing fast, economical construction and maintenance operations on roads, airports and similar projects. See your nearest Adams dealer for complete details.

J. D. ADAMS MANUFACTURING CO.
INDIANAPOLIS, INDIANA
Sales and Service Throughout the World

ADAMS

ROAD-BUILDING AND EARTH-MOVING EQUIPMENT

Bethlehem Steel for POST-WAR HIGHWAYS

It's going to be a huge post-war job, building the new highways needed by a growing America, carrying out hundreds of construction projects that had to lie fallow during the wartime years.

When the job begins, Bethlehem's complete line of highway products will again be at the service of road builders. Bethlehem road steels, backed by years of experience, have proved themselves — they're engineered all along the line for sturdy performance.

Plan to handle your post-war highway contracts by specifying this reliable source of supply for *all* road-steel products. Contractors can save time, bookkeeping and letter-writing by placing one order for all their needs for a given highway job with a conveniently-located Bethlehem warehouse. For full information about Bethlehem Road Steel Service, get in touch with the nearest district office, or write direct to Bethlehem Steel Company, Bethlehem, Pa.

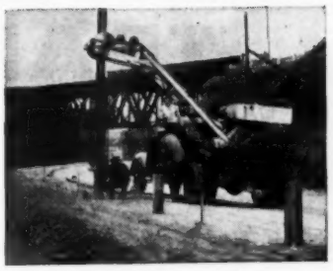
REINFORCING STEEL

Bethlehem *Reinforcing Bars,* plain and deformed, are made of new billet steel in standard sizes and grades, and can be bent to shape and cut to size in most Bethlehem warehouses. *Bar Mats,* made of deformed bars clipped together, are easy and convenient to install, and lie flat. *Welded Wire Fabric* is fabricated from tough, cold-drawn wire to meet all standard highway specifications.

HIGHWAY GUARD

Bethlehem's beam-type guard rail, called the *Safety-Beam,* is made in standard 12 ft., 6 in. lengths, or if preferred, can be supplied in lengths up to 50 ft. *Cable Guard Rail* is durable three-strand steel cable, with a double-galvanized coating. *Highway-Guard Bracket,* made of high-tensile spring steel, is attached with one bolt to steel or wood posts, and supports three or four cables.

STEEL POSTS



Bethlehem *Steel Highway Guard Posts* are readily driven and have superior resistance to impact and side thrust. Bethlehem also makes posts for right-of-way fence, as well as the fence itself.

STEEL PILING

Bethlehem *Steel Sheet Piling* for temporary or permanent retaining structures. *Steel H-Bearing Piles* for bridges, over- and under-pass, and other load-bearing structures.

BETHLEHEM STEEL

OTHER BETHLEHEM PRODUCTS FOR HIGHWAYS

ROAD JOINTS — DOWELS — DOWEL BAR SUPPORTS
ROAD STRIP — WIRE ROPE AND STRAND — BAR TIES
GUARD RAILS — ANCHOR RODS — RIGHT-OF-WAY FENCE AND POSTS
PIPE — HOLLOW DRILL STEEL — DIGGING BARS
STRUCTURAL STEEL — STEEL CRIBBING MOLD BOARDS
REINFORCING FOR CONCRETE — BRIDGE FLOOR REINFORCING
CORRUGATED SHEETS — CONCRETE SLAB SPACERS
TURNBUCKLES — TIE RODS, SPIKES, BOLTS AND NUTS
TIMBER BRIDGE HARDWARE

ROADS AND STREETS

Vol. 88, No. 6 June, 1945

CCA

A magazine devoted to the design, construction, maintenance and operation of highways, streets, bridges, bridge foundations and grade separations, and to the construction and maintenance of airports.

WITH ROADS AND STREETS HAVE BEEN COMBINED GOOD ROADS MAGAZINE AND ENGINEERING & CONTRACTING

HALBERT P. GILLETTE, President; EDWARD S. GILLETTE, Publisher; HAROLD J. McKEEVER, Editor; CHARLES T. MURRAY, Managing Editor; JOHN C. BLACK, Field Editor; LT. COL. V. J. BROWN, Publishing Director (Absent on Military Duty); H. J. CONWAY, Advertising Editor; L. R. VICKERS, Promotional Director.

CONTENTS

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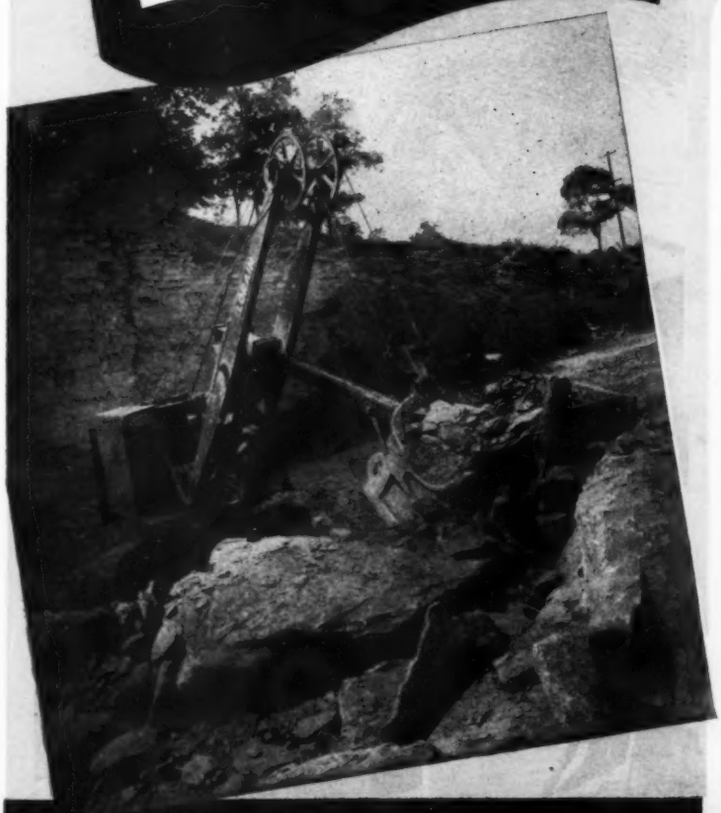
24 REASONS for making the next one a LORAIN!



1. Center Drive turntable.
2. Permits concentrating power on any one operation.
3. Permits spreading power for high-speed simultaneous operations.
4. Two-piece swing drums, roller bearing mounted, reversible bands.
5. Extra wide crowd clutch, roller bearing mounted.
6. Hydraulic coupling—no stall, no shock, no loafing; (used on L 82 and L 820).
7. Center "Chain" Drive crawler.
8. Two travel speeds either direction.
9. Steers either direction.
10. Safety travel and tread lock.
11. Mechanism runs in oil bath.
12. Generous underneath clearances.
13. Centralized lubrication.
14. Wider treads.
15. All-welded shovel boom (strength; all-steel; torsion-resisting).
16. All-steel welded dipper stick.
17. Dipper door stops to protect stick.
18. "Elbow action" power dipper trip.
19. Simultaneous hoist, swing and travel (or boom derricking).
20. High-speed boom hoist—power controlled boom derricking and lowering.
21. "Cable-Miser" fairlead with interlocking, geared sheaves.
22. Bolted butt crane boom connections, easy and quick to assemble.
23. All-purpose Crane Boom Head—6 part reeving with no top block; greater vertical reaches.
24. Backdigger Boom—with controlled tilting dipper; digs a vertical wall, a level floor, dumps exactly where wanted.

NOTE: All Lorain machines are fully and easily convertible for use as cranes, clamshells, draglines, shovels and backdiggers. Don't buy a single-purpose machine; keep future jobs in mind. One machine—one investment—can do a wide variety of jobs for extra profits!

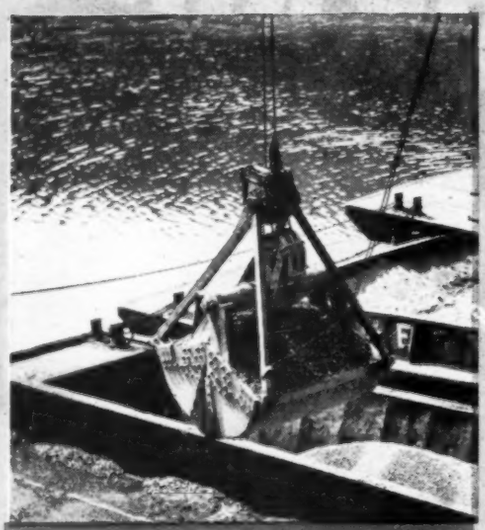
Reg. Trade Mark

thew-Lorain

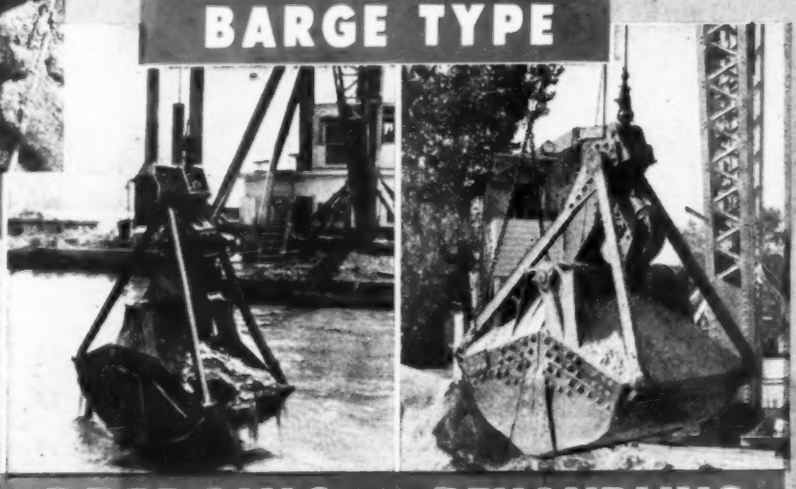
THE THEW SHOVEL CO.
LORAIN, OHIO

CRANES • SHOVELS • DRAGLINES • MOTO-CRANES

HARD DIGGING



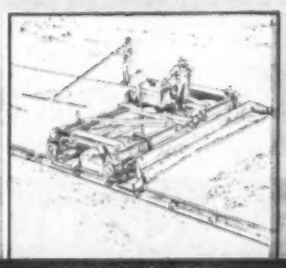
BARGE TYPE



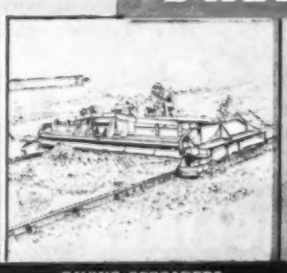
DREDGING REHANDLING

ARMY NAVY

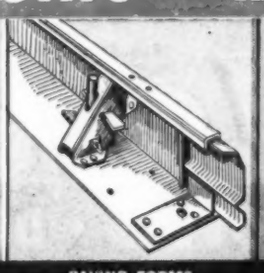
7 plants of Blaw-Knox Company have been awarded the Army-Navy "E" for excellence



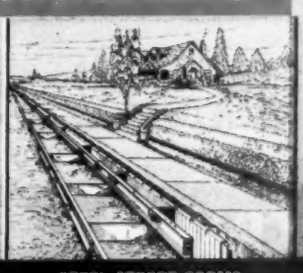
FINISHING MACHINES
FOR ROADS AND AIRPORTS



PAVING SPREADERS
FOR ROADS AND AIRPORTS



PAVING FORMS
FOR ROADS AND AIRPORTS



STEEL STREET FORMS

THE *Right* BLAW-KNOX CLAMSHELL BUCKET FOR YOUR JOB

You have only to specify the size of crane and kind of work you want a clamshell bucket to do and Blaw-Knox will furnish the proper type and size to suit your particular requirements — do your work efficiently, quickly and at lowest possible cost.

The selection will come from the largest line of clamshell buckets available anywhere — all highly engineered — and field proved to do the job and take the hard knocks of rough usage.

Such outstanding developments as ball-bearing lever arm sheaves (instead of ordinary bushings) which mean easier operation and longer cable life; proper weight distribution basically designed into the bucket (instead of trying to do it all with counter-weights) which provides greater penetration and digging power; one-piece main hinge which insures and maintains positive scoop alignment at all times — these and many other built-in advantageous features of bucket design become yours when you buy a Blaw-Knox Clamshell Bucket for your job.

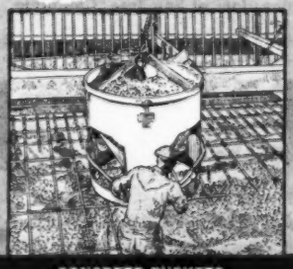
Your nearest Blaw-Knox Dealer will help you select the bucket you need.

Send for Catalog 1757—A complete data book on Blaw-Knox Two-line Clamshell Buckets

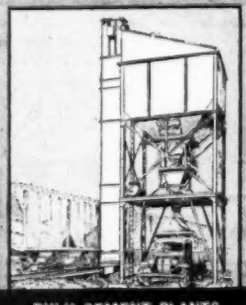
BLAW-KNOX

BLAW-KNOX DIVISION
OF BLAW-KNOX COMPANY
2003 Farmers Bank Bldg., Pittsburgh, Pa.
NEW YORK • CHICAGO • PHILADELPHIA
BIRMINGHAM • WASHINGTON
Representatives in Principal Cities


AGGREGATE BATCHING PLANTS


CONCRETE BUCKETS


SHEEPSFOOT TAMPING ROLLERS


BULK CEMENT PLANTS

Traxcavator digging up old street surfacing in a Virginia town.

Traxcavator grading between lanes on U. S. Highway 30, near Valparaiso, Indiana.

OPERATORS KNOW THE WORD FOR IT—

"TRAXCAVATING!"

TRAXCAVATORS do so many tasks well that operators coined a word to cover all of them. It's "Traxcavating!" It fits TRAXCAVATORS like a glove, for these multi-purpose machines, powered by "Caterpillar" track-type tractors, dig, grade, load, carry and do many other earth-moving and material handling jobs easily, quickly and at low cost. Ask your Trackson — "Caterpillar" dealer how TRAXCAVATORS can help you, or write to TRACKSON COMPANY, Dept. RS65, Milwaukee 1, Wis.

Traxcavator excavating and loading for barracks foundations at an army camp, Indianapolis, Ind.

Traxcavator preparing right-of-way for a cross-country pipe line in Illinois.

Traxcavator backfilling between walls of a percolating dam at San Jose, California.

● Below are a few of the hundreds of "Caterpillar" Diesels that have already registered TWO TO FIVE TIMES "9999" working hours . . . and are still going strong.

Owner*	Classification	Hours
TRACTORS and MOTOR GRADERS		
S. V. Christierson	Farming	59,000
Heber W. Glenn	Farming	54,000
H. M. Thompson & Co.	Oil Field	52,520
Barogar Bros.	Farming	45,000
E. C. Von Glahn	Farming	38,000
Frank Colt	Farming	36,000
R. M. Jensen	Contracting	33,960
R. M. Jensen	Contracting	32,880
Oahu Sugar Co.	Farming	32,000
Hawaiian Pineapple Co.	Farming	31,017
D. A. Kessler Constr. Co.	Contracting	31,000
Gilbert Courtright	Farming	30,000
W. D. Annis	Contracting	30,000
ENGINES		
A. J. Kroeker & Co.	Industrial	65,000
Denwood Oil Co	Industrial	60,000
Rosenthal & Carter	Oil Field	46,525
Mt. Emily Lumber Co.	Logging	43,000
Fairview Lt. & Power Co.	Industrial	35,000
Capparell Stripping & Construction Co.	Mining	33,600
Belton Hatchery	Industrial	32,272
S. A. Murphy	Oil Field	30,240
M. DeRome	Contracting	28,000
W. E. Johnson	Industrial	26,616
Bridgeport Oil Co.	Oil Field	26,320
M. O. Weaver, Inc.	Contracting	25,600
Massaponax Sand & Gravel Co.	Industrial	25,000

*Addresses on request

The HOUR-METER—standard equipment on every "Caterpillar" Diesel Engine, Tractor and Motor Grader—is witness particularly to their stamina and long life. And the testimony it has collected over the years is a revelation!

The "Caterpillar" hour-meter records full "work hours." Driven direct from the crankshaft, its dial registers up to 9999 hours (which at one time users of power equipment considered a liberal serviceable life-span for a heavy-duty unit). But through their inbuilt soundness, hundreds of "Caterpillar" Diesels have multiplied in work hours the capacity of the meter.

At the right are a few of the notable hour records—as taken from latest available reports. Behind these records for long, dependable and economical performance is the outstanding "Caterpillar" dealer inspection, mechanical and replacement-parts service . . . plus "Caterpillar's" 40-year bank of track-type tractor experience, which no other manufacturer in its field commands.

CATERPILLAR TRACTOR CO. • PEORIA, ILLINOIS

CATERPILLAR DIESEL

REG. U.S. PAT. OFF.

ENGINES • TRACTORS • MOTOR GRADERS • EARTHMOVING EQUIPMENT

205 HALF-YARD

Saves ONE-HALF *the Cost* OF AN EXTRA PULL SHOVEL BOOM

You save one-half the cost of separate pull shovel boom. The same features that make the Two-in-One boom a better shovel boom, make it a better pull shovel boom as well. Rigidity and strength, built in to meet shovel requirements, eliminate dipper weaving on the pull shovel, makes possible full use of sidecutters. The boom foot drum that gets a double cable pull into the shovel crowd action also gets a double cable pull into the pull shovel digging action.

KOEHRING COMPANY
MILWAUKEE 10, WISCONSIN

HEAVY-DUTY CONSTRUCTION EQUIPMENT

Now LAY·SET is—

The new GREEN LUBE, *made to Hazard's own specifications, clings to the wires better, thereby affording increased protection. Wires wear longer; the entire rope gives longer service. That is why every strand in* **LAY·SET** *Preformed I.P.S. is packed to the point where every void is completely filled with this superior lubricant.*

ACCO

Wilkes-Barre, Pa., Atlanta, Chicago, Denver, Los Angeles, New York, Philadelphia, Pittsburgh, Portland, San Francisco, Tacoma, Bridgeport, Conn.

HAZARD WIRE ROPE DIVISION
AMERICAN CHAIN & CABLE

ACCO TRADE MARK

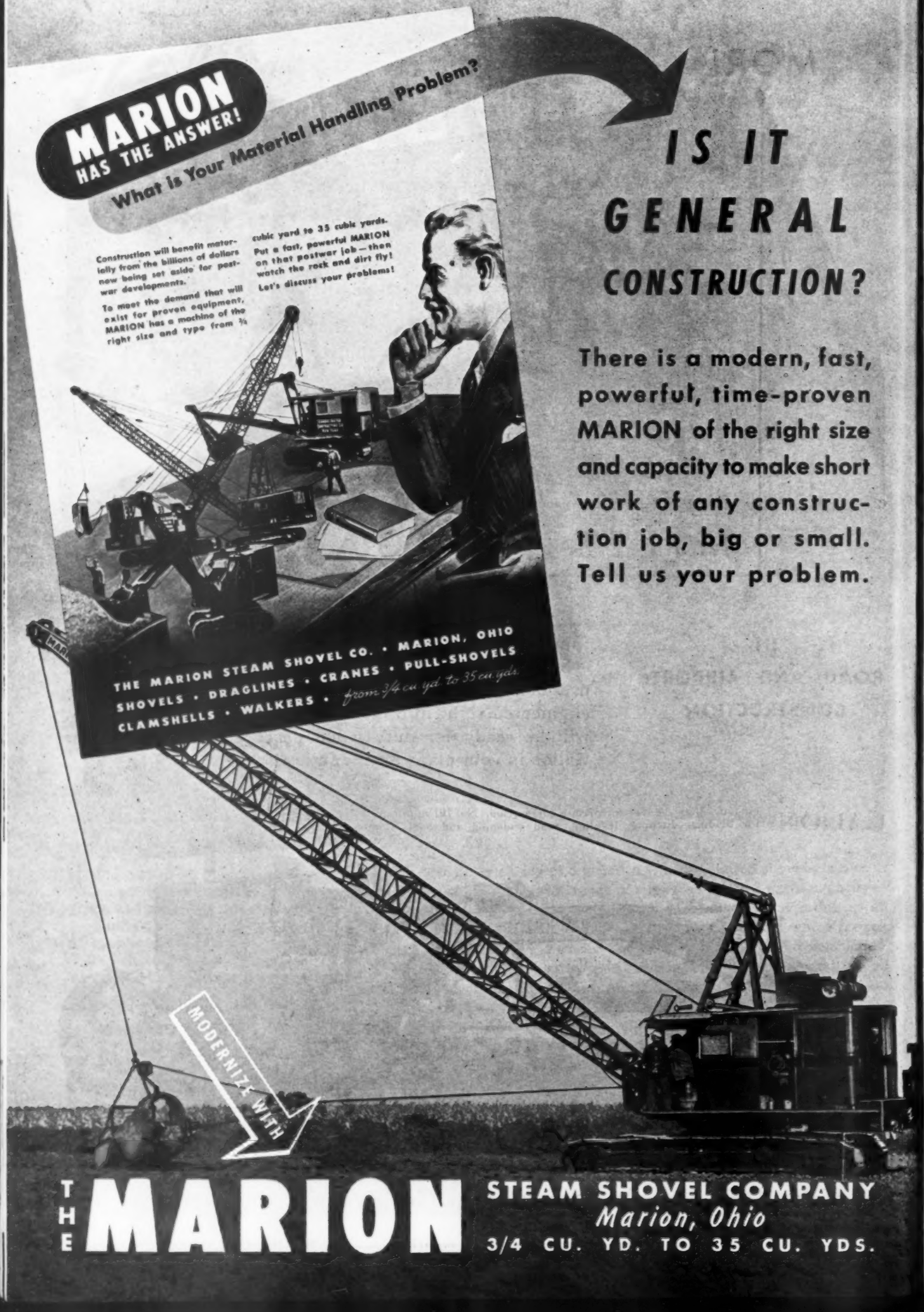
In Business for Your Safety

PREFORMED I.P.S.*

ALL GREEN!

Here is the ultimate in wire rope perfection. ... Hazard **LAY·SET** Preformed made of Improved Plow Steel *... every strand of which is literally stuffed with our superior green lubricant ... the best of all rope made still better by the more adhesive green lubricant which coats every wire.

★ ★ ★ ★ ★


MARION
HAS THE ANSWER!
What is Your Material Handling Problem?
Construction will benefit materially from the billions of dollars now being set aside for postwar developments.
To meet the demand that will exist for proven equipment, MARION has a machine of the right size and type from ¾ cubic yard to 35 cubic yards.
Put a fast, powerful MARION on that postwar job—then watch the rock and dirt fly!
Let's discuss your problems!
THE MARION STEAM SHOVEL CO. • MARION, OHIO
SHOVELS • DRAGLINES • CRANES • PULL-SHOVELS
CLAMSHELLS • WALKERS • from 3/4 cu yd to 35 cu yds.
IS IT GENERAL CONSTRUCTION?
There is a modern, fast, powerful, time-proven MARION of the right size and capacity to make short work of any construction job, big or small. Tell us your problem.
MODERNIZE WITH
THE MARION STEAM SHOVEL COMPANY
Marion, Ohio
3/4 CU. YD. TO 35 CU. YDS.

because it digs, SWINGS, hoists and dumps in ONE continuous movement

Loads Trucks *3 TIMES FASTER*

This all-purpose Loader fills a long-felt need for contractors, highway depts., counties, municipalities, quarries... With 180° swinging boom and power-closing bucket it loads to either side in one continuous movement—with 11 fewer clutch moves, in 1/3 the usual time... NO MANEUVERING — WORKS IN TIGHT PLACES . . . Crowding power is tremendous — with 65 h.p. engine in ¾ m.p.h. low gear and 80% of load on giant front driving wheels it can dig into any material, backfill, grade, do prime moving and light excavating . . . And with 6 traction speeds and power steering it travels to jobs anywhere at 15 m.p.h. Send for 52 page Catalog JL-5.

FLEETFOOT

JAEGER LOADER

CRANE and EXCAVATOR

THE JAEGER MACHINE COMPANY

Main Office and Factory, Columbus, Ohio

REGIONAL OFFICES: 8 E. 48th St. NEW YORK 17, N. Y. — 226 N. La Salle St. CHICAGO 1, ILL. — 235-38 Martin Bldg. BIRMINGHAM 1, ALA.

½ to 2 Yd. Buckets, Quickly Interchangeable—Handle Any Material from Rock to Snow

12-25 Ft. Crane Attachment

Grades, Backfills, Cleans Up; Loads Earth, Coal, Snow

Can Dig Outside Its Wheels . . Can Dig 3 Ft. Below Grade

You won't find GENERAL EXCAVATOR listed in the Mortality Tables!

EVERY GENERAL BUILT SINCE 1927, ON WHICH THERE IS A RECORD, IS STILL AT WORK!

It's a fact! Every General Excavator built during the past 18 years, on which we are able to check, is still in action: doing a good day's work every day. Our records cover 98% of all Generals manufactured; the other machines are those sold by their original owners and on which we do not have recent information.

That's the kind of a performance record that has built confidence in General Excavators and Supercranes . . . confidence that will mean even more Generals at work during the postwar era. Include General in *your* postwar equipment plans! Get all the facts about the complete General line and be sure to inquire about the revolutionary new . . .

GENERAL TYPE 10

Combination Crane, Shovel, Dragline and Backhoe—One Man Controlled—One Engine Operated—On Rubber Tires

POSTWAR PRIORITY ORDERS NOW BEING BOOKED

BUY MORE WAR BONDS—KEEP THE BONDS YOU BUY

THE OSGOOD COMPANY
SHOVELS, DRAGLINES
CRANES
CRAWLER & WHEEL MOUNTS
DIESEL, OIL, GAS, ELECTRIC

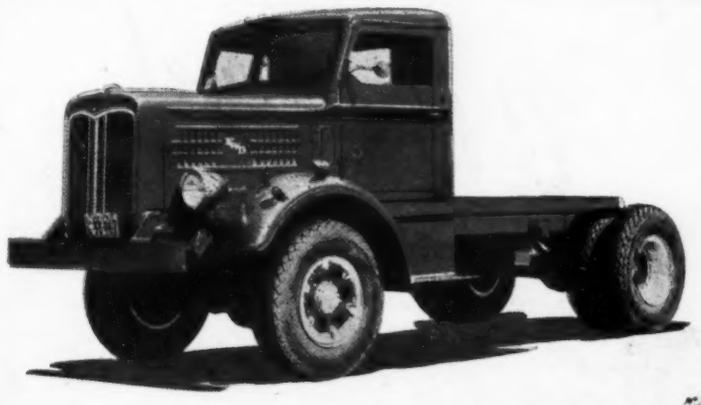
Associated with The Osgood Company

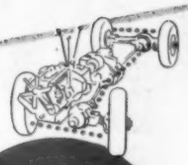
GENERAL EXCAVATOR CO.
MARION, OHIO

CRANES, DRAGLINES AND SHOVELS

SPEED with SAFETY....

Plus Ample Reserves of "Going Power" for Any Emergency





Whether it's new highway construction or seasonal maintenance work — blading a road, hauling material, clearing snow — or an emergency job demanding better than usual truck performance, rely on an FWD to do the work with speed — safety — low cost.

The superior performance and stamina of FWDs in all classes of highway work originates in experienced, specialized four-wheel-drive engineering — engineering that provides the highest development of the true four-wheel-drive principle with center differential — engineering that equalizes power and load distribution — engineering that divides working strains over two driving axles — engineering that means a rugged, dependable highway "worker" in every detail.

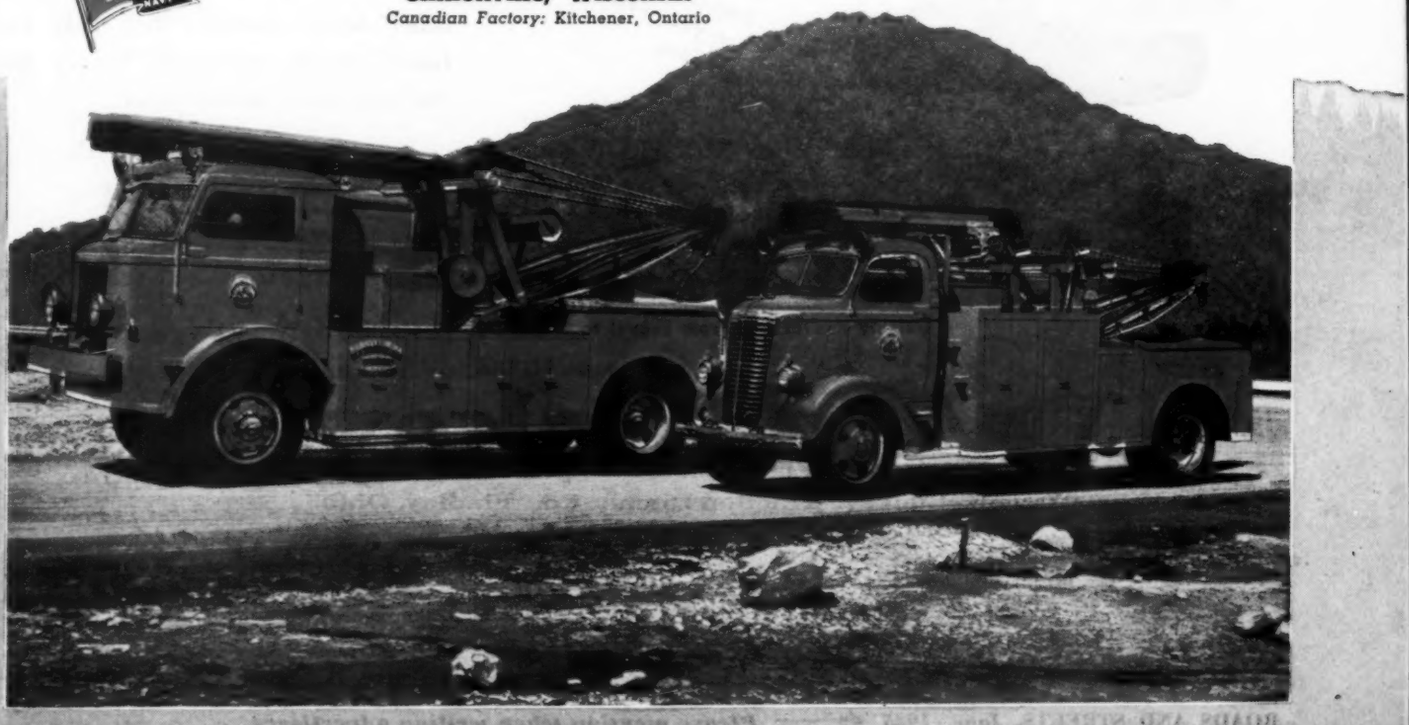
There are good reasons why FWD trucks are the first choice of highway men.

Write us or see your FWD dealer for information on available FWD trucks.

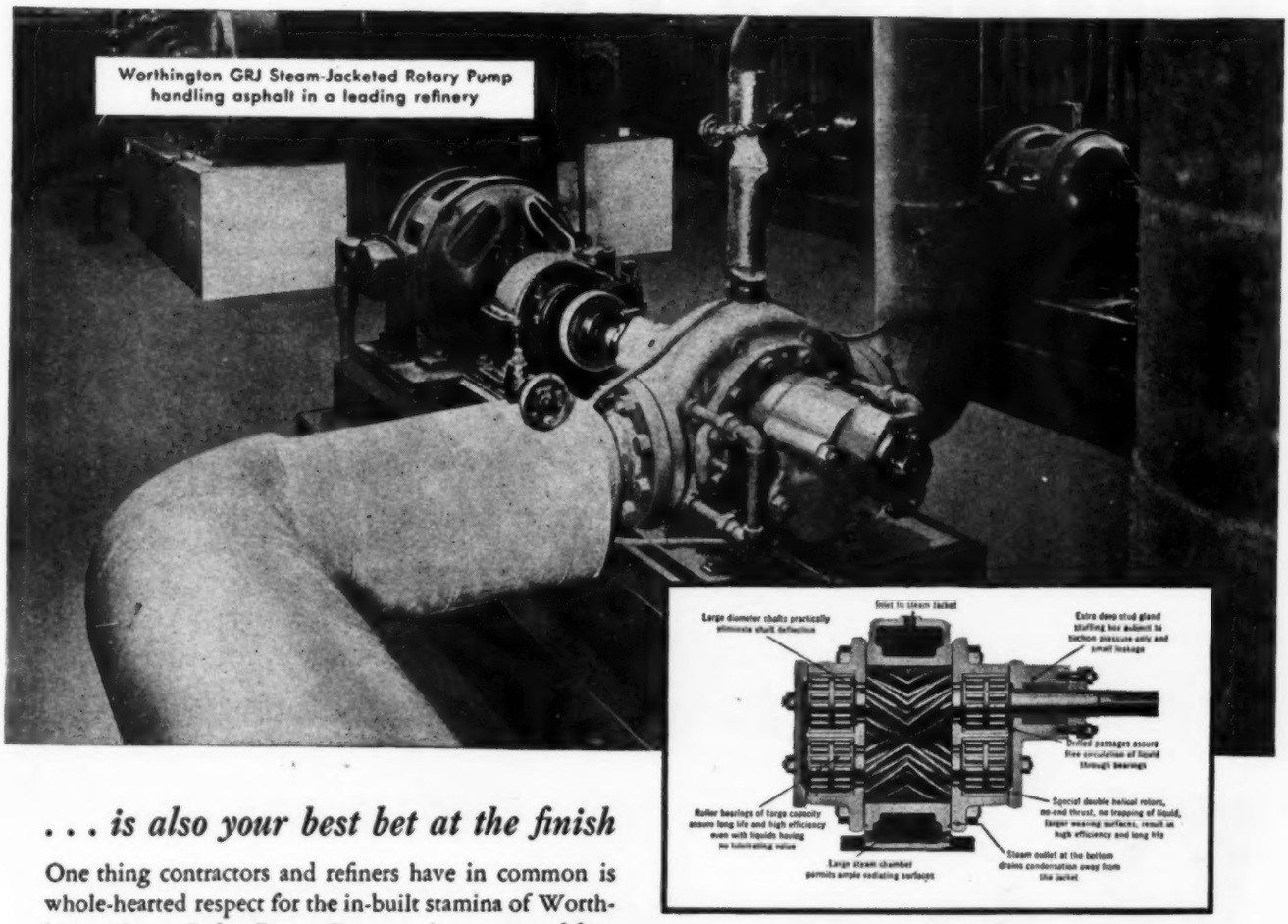
FWD TRUCKS

THE ORIGINAL EXCLUSIVE BUILDERS OF FOUR-WHEEL-DRIVE TRUCKS

THE FOUR WHEEL DRIVE AUTO COMPANY
Clintonville, Wisconsin
Canadian Factory: Kitchener, Ontario



THE STEAM-JACKETED PUMP THAT GETS ASPHALT OFF TO A GOOD START



. . . *is also your best bet at the finish*

One thing contractors and refiners have in common is whole-hearted respect for the in-built stamina of Worthington Steam-Jacket Rotary Pumps. As a matter of fact, many contractors don't even know that Worthington GRJ Rotary Pumps are installed right in their road oilers, pavers, and trucks. That's because these dependable asphalt handlers have a habit of staying out of trouble . . . so never call attention to themselves.

That's why you'll want to have these same trouble-dodgers keeping asphalt on the go from tank cars to storage tanks to tank trucks to the machines that apply it.

GET ALL THE FACTS

For vital facts a contractor should know about Steam-Jacketed Rotary Pumps for handling asphalt, write for Bulletin W487-B11. It proves that *there's more worth in Worthington. Worthington Pump and Machinery Corporation, Harrison, N. J.*

WHY WORTHINGTON GRJ ROTARIES CAN TAKE IT

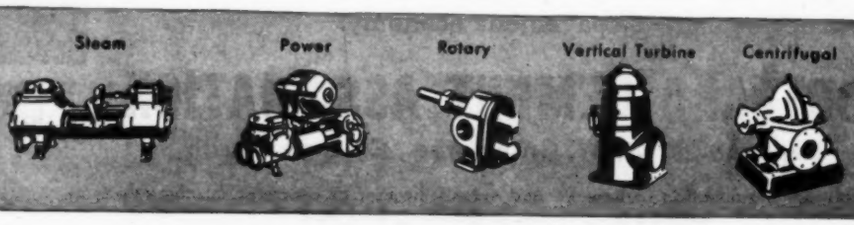
1. **ROLLER BEARINGS** with more capacity than any other rotary pump.
2. **STUFFING BOX** much deeper than the average.
3. **SPECIAL DOUBLE HELICAL ROTORS** with larger wearing surfaces, free from end-thrust.
4. **HUSKY SHAFTS** mean trouble-free stuffing boxes.

MEMBER

WORTHINGTON

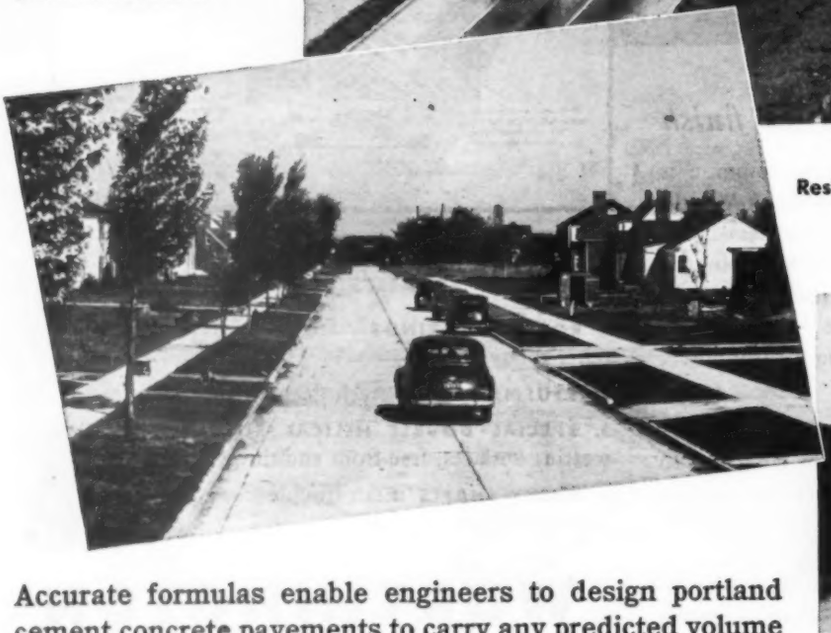
P 5-10

THE WORLD'S LARGEST MANUFACTURER OF PUMPS



CONCRETE *the low annual cost pavement*

Davison Limited Access Highway, Detroit. *10-in. uniform cross section.*



Residence street in Saginaw, Michigan. *7½-5-7½ in. cross section.*

State highway in Oklahoma carrying moderately heavy rural traffic. *9-6-9 in. cross section.*

Accurate formulas enable engineers to design portland cement concrete pavements to carry any predicted volume and weight of traffic at lowest maintenance expense. This plus the fact that concrete, for all but the lightest traffic roads, usually costs less to build than any other pavement of equal load-carrying capacity, means low annual cost, the true measure of pavement economy.

PORTLAND CEMENT ASSOCIATION

Dept. A6-28, 33 W. Grand Ave., Chicago 10, Ill.

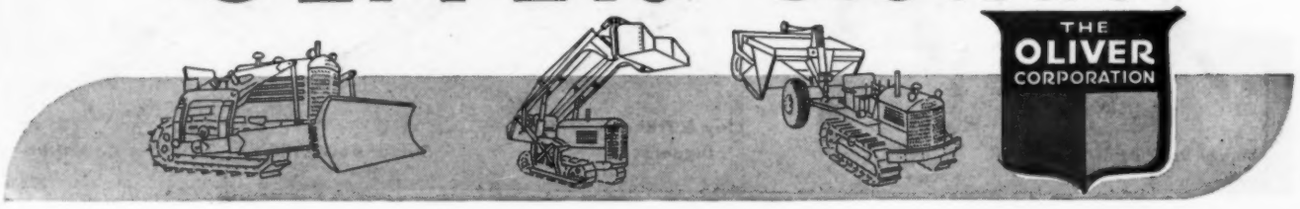
A national organization to improve and extend the uses of concrete . . . through scientific research and engineering field work

• They're right at home in water or mud, these husky Oliver "Cletrac" crawler tractors. The positive sealed construction of the lower track wheels keeps mud and water out . . . keeps oil in to protect against damage and wear. Each end of the bearing is fitted with a double dirt-oil seal, another Oliver "Cletrac" feature, that materially prolongs the life of the lower track wheels.

And, Oliver "Cletrac's" *controlled differential steering* is a big help when operating in mud or water, especially when the tractor is equipped with front-end loading equipment such as the Drott Bull Clam shown here. This exclusive principle means greater traction . . . less wear on steering parts. Power is never disconnected from either track when turning, assuring a steady flow of pushing or pulling power plus greater safety on hills and turns.

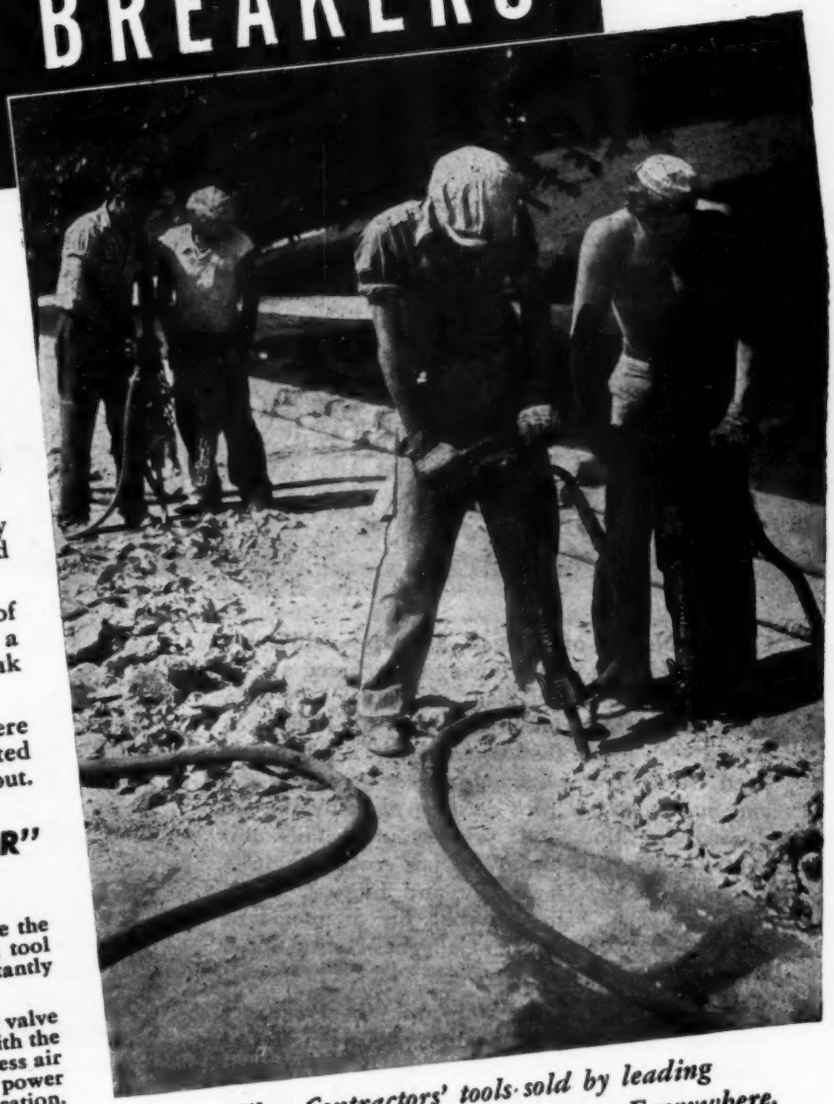
Oliver "Cletrac" tractors are ruggedly built for long, dependable service. Drop forged and rolled steel construction eliminates excess dead weight . . . adds strength. Their unusual accessibility makes maintenance a simple task. Substantial numbers of Oliver "Cletracs" are now being released for essential service. Your Oliver "Cletrac" dealer will gladly assist you in making application for a new tractor. **The OLIVER Corporation,** Industrial Division, 19300 Euclid Avenue, Cleveland, Ohio.

OLIVER - Cletrac



AS THEY ARE IN SERVICE AT HOME

PAVING BREAKERS



WHAT *Thor* "MEASURED AIR" MEANS TO YOU...

1. Balanced Power—because only a precisely governed quantity of air is allowed behind the piston.

2. Smooth Performance—because every stroke is powered by the same measured quantity of air.

3. Air Economy—because every ounce of air which enters the machine provides a full measure of maximum power for peak efficiency performance.

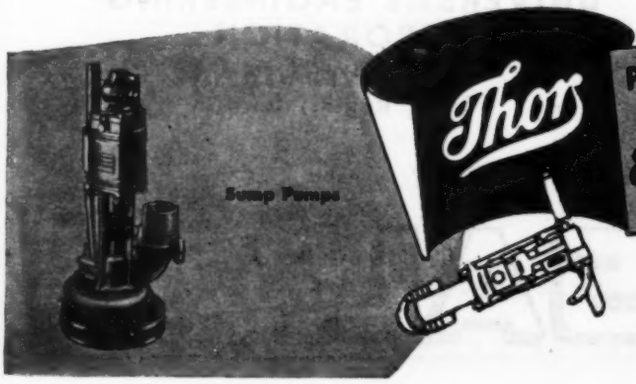
4. Low Maintenance Cost—because there are no separate parts of the patented Thor valve to become lost or wear out.

HOW THOR "MEASURED AIR" ECONOMY WORKS . . .

The shorter the travel, the more positive the action of the valve in admitting to the tool only the required amount of air—in instantly sealing the outlet against excess air.

Short travel of the Thor Paving Breaker valve action powers each stroke of the tool with the same quantity of air. Elimination of excess air keeps out of the channel the overload of power that staggers the stroke and causes vibration.

Thor Contractors' tools sold by leading Construction Equipment Distributors Everywhere.



PORTABLE *Electric & Pneumatic* TOOLS

Branches in Principal Cities

For more detailed information about the powerful, easy-operating Thor Paving Breakers and other Thor contractors' air tools, write for Catalog 42-A.

INDEPENDENT PNEUMATIC TOOL CO.
600 W. Jackson Blvd., Chicago 6, Ill.
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P's and Q's for 546's and 822's PITS and QUARRIES

A general view of Gallager-Nelson's Universal 546-P primary crushing unit and "800" secondary crushing unit forming the "822-Q" quarry plant shown working near Polo, Ill. Note the close-coupled compactness of this electrically-powered rock reduction plant.

Gallager-Nelson of Oregon, Ill., know their P's and Q's. Having some time ago purchased a Universal No. 800 gravel plant consisting of a 40″x 22″ roller bearing roll crusher, 4′ x 12′—2½ deck screen with a 30″ feed conveyor on a pneumatic tired truck, *it was a simple matter to convert this unit into an 822-Q rock crushing plant* by the addition of a No. 546-P primary unit. This unit consists of a 20″ x 36″ WRB jaw crusher, a 36″ x 8′ apron feeder, a grizzly and by-pass, a 30″ under-conveyor—all mounted on a pneumatic tired truck. We repeat—Gallagher-Nelson know their P's and Q's.

An inbuilt feature of Universal gravel and rock crushing, screening and loading plants long recognized by contractors and public works officials is the ease with which new standardized units may be added to increase capacity, to change over from gravel to rock crushing or to add washing or other processing not included in the original plant.

Ask your Universal dealer to show you these exclusive design features common only to Universal-engineered equipment.

Close-up of the 546-P primary unit. Electrically-driven, it consists of a 20″ x 36″ WRB jaw crusher, a 36′ x 8′ apron feeder, a grizzly with by-pass and a 30″ under-conveyor.

UNIVERSAL ENGINEERING CORPORATION

631 C AVE. West
Cedar Rapids, Iowa

ARMY E NAVY

UNIVERSAL

ROCK AND GRAVEL CRUSHERS, CRUSHING ROLLS, HAMMER MILLS, COMPLETE CRUSHING AND SCREENING PLANTS, WASHING PLANTS, ASPHALT PLANTS, SPREADEROLLERS.

REMEMBER THE DAYS WHEN YOU CHOSE UP SIDES . . . AND HOW IMPORTANT IT WAS TO GET IN "FIRST LICKS"?

This typical American trait of getting there first . . . of staying a jump ahead of the other fellow . . . will be mighty important now that V-E Day permits many peacetime operations to be resumed.

The construction industry will lead the way and those firms, ready *first* to undertake the important work that lies ahead—and well equipped with the necessary machinery to do the job—will enjoy a hard-to-overcome advantage over less progressive competitors.

C.I.T. is sponsoring a brand-new financing plan for the purchase of construction equipment—different in terms, lower in cost and simpler in operation—that makes it easy for dealers and contractors alike to meet the demand for much needed machinery without depleting working capital.

Any sound enterprise, large or small, can arrange with C.I.T. for this financial backing, promptly and without lengthy negotiations. The cost of equipment purchases can be amortized over many months; there's no interference with business and working funds are left free for operating use.

This is the time for industry to get in "first licks." If additional capital will help you get off to a flying start, inquire about this newly developed finance plan. Write, wire or phone our nearest office for information without obligation.

C. I. T. CORPORATION

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AFFILIATED WITH COMMERCIAL INVESTMENT TRUST INCORPORATED

TRUSCON TRU-CURE for CURING CONCRETE

SPRAY IT ON

No paper — No burlap

Produces better concrete

One-Man operated Tru-Cure Multiple-Nozzle Applicator. (Patented)

ONE MAN CURING

Continuous Operation — Right Behind the Finisher

Since extended research has proved the astounding effectiveness for moisture-retention of Truscon Tru-cure type of curing film—it now becomes a matter of applying that curing film over large concrete areas in such a manner that there will be no breaks or leaks in the film's continuity.

For that purpose, the one-man-operated, TRU-CURE Multiple-Nozzle Applicator shown above was designed and built by Truscon concrete engineers.

Scientific tests have proved this to be the fast, time-saving and dependable method of applying the transparent, water-retaining concrete curing compound to a uniform thickness. It lays a protective film over all the concrete surface—no "skips" on thin spots.

This convenient, efficient, one-man applicator is one of Truscon's contributions to "better concrete." Properly cured concrete is better concrete.

These TRU-CURE Machines have helped make possible the nation's tremendous airport and military roadway expansion. Machines are available, either through the sales agencies of the Truscon Laboratories, or are built by machinery dealers for road contractors. Blue prints and specifications may be had, no charge, by communicating with address below, or any Truscon Laboratories' office.

TRUSCON TRU-CURE

Used on millions of square feet of concrete—Truscon Tru-Cure met the war emergency for more roads, and better roads, rapidly constructed. It has proved to be the most successful method of curing large concrete areas—factory floors, roof slabs, highways, airport runways.

Tru-Cure curing follows right behind the finisher—no time lost—makes possible water retention during that early critical period where lack of curing causes hair checks and shrinkage cracks in concrete.

Equivalent to 14-day water curing—no burlap—no paper—no worry about keeping concrete wet—no cleaning up afterwards.

Truscon Tru-Cure is a clear liquid—requires no removal, as film weathers off in a short time. Approved by United States Army Engineers and numerous State Highway Departments.

Ask for descriptive literature.

TRUSCON LABORATORIES Inc. DETROIT MICHIGAN

Gulf Quality Products and Fine Service help contractors keep ahead of schedule on another big airport job!

Two views of work in progress on Wood County airport, near Parkersburg, West Virginia, where Ralph Myers Construction Company of Salem, Indiana, and Western Contracting Company of Sioux City, Iowa, are moving 27,000 yards per day to keep well ahead of schedule.

RALPH MYERS Construction Company and Western Contracting Company are pushing equipment to the limit twenty hours a day to complete the airport project pictured above well ahead of schedule. Gulf quality lubricants and fuels help keep all this equipment on the job and working at top efficiency. These contractors know from experience that it's good profit insurance to specify Gulf products!

Leading contractors on all types of earth-moving jobs depend on Gulf quality products and fine service to help them beat contract schedules. For proper lubrication and efficient fuel performance result in less time out for their equipment, longer life, and less expense for maintenance.

Write, wire, or phone your nearest Gulf office today and arrange to use Gulf higher quality lubricants and fuels on your next job. Available to you through more than 1200 warehouses located in 30 states from Maine to New Mexico, they will help you complete it more quickly and at a larger profit.

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Totalitarian enemies have learned . . . the hard way . . . that our B-17's, B-24's and B-29's all pack a lethal sting. We're proud of the job America's B's have done, and are doing . . . proud, too, of the fact that hundreds of Huber Rollers, busy on airfield and airstrip construction and maintenance in every quarter of the globe, have helped pave the way for their sorties.

THE HUBER MFG. COMPANY • MARION, OHIO, U. S. A.

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SET THE PACE FOR ITS CLASS

THE fast-drilling, 56-pound CP-42 Sinker features a sturdy, trouble-free, single retainer spring encircling the front end — lengthening service life and lowering maintenance cost. Ideal for general excavation, shaft sinking, road work and quarry drilling. Economical in air consumption. Powerful air blow keeps even the deepest holes free from cuttings. Prove the pace-setting advantages of the CP-42 Sinker Drill under your own operating conditions. Arrange for a demonstration.

There's a CP Sinker for every purpose, from the 28-pound CP-22 to the 119-pound, heavy duty CP-60. All are convertible to wet machines.

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In making a decision on the diesel you'll want for your heavy-duty earth moving and material handling equipment, consider *all* the "angles" . . . the men who build it . . . use it . . . service it.

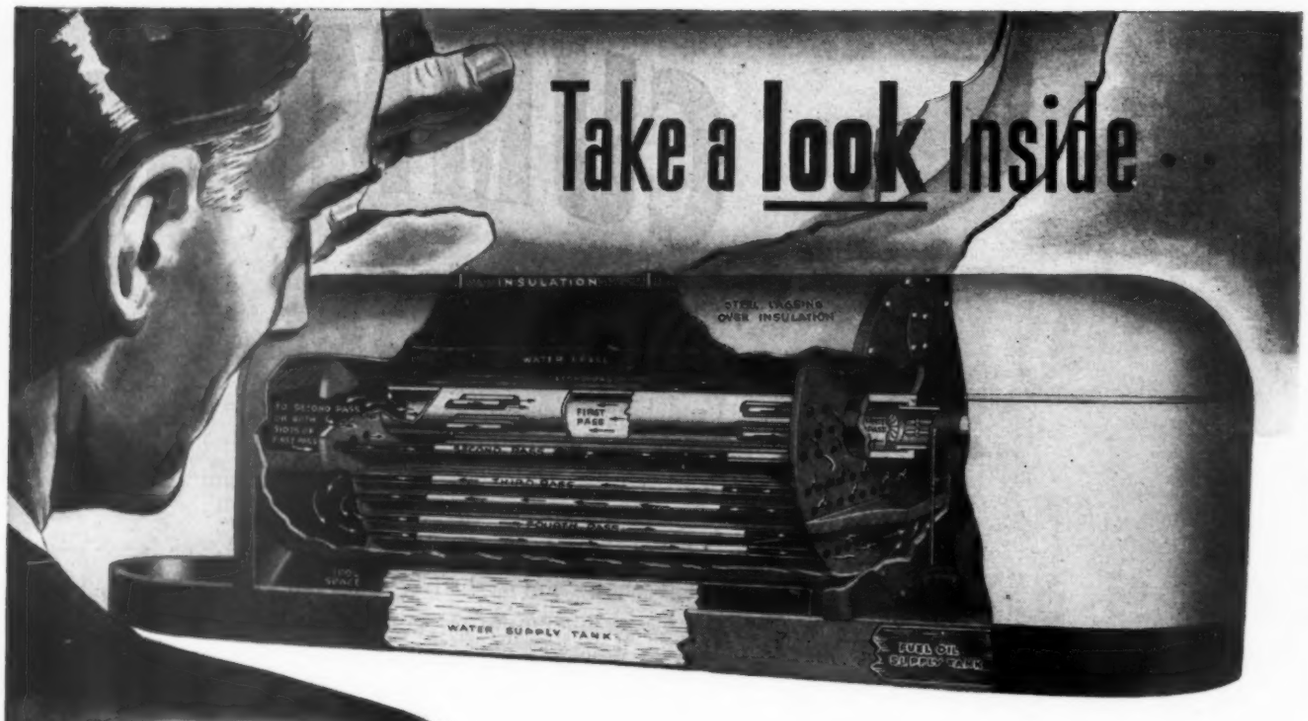
More than 26 years of manufacturing experience devoted wholly and exclusively to diesels are represented in the modern Cummins Dependable Diesel . . . your assurance of the most advanced design and construction.

The list of Cummins Diesel owners includes many of the best-known and most successful operators in the construction and aggregates industries . . . your assurance that Cummins Diesels have long been doing the very job you want done.

Cummins Dealers provide complete service facilities throughout the nation. They know the engine and know how to take care of it . . . your assurance that your Cummins Diesels will never be far from competent *Cummins Service.*

Built by men who are *diesel specialists* . . . the choice of men who demand the best in power . . . backed by dealers who fully appreciate the importance of service . . . these are the reasons why Cummins Dependable Diesels are your most profitable investment in power.

CUMMINS ENGINE COMPANY, INC., COLUMBUS, INDIANA



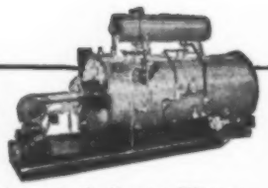
..to see why you get hot, dry steam faster with less fuel and water

● The cross-section illustration graphically shows the famous Cleaver-Brooks four-pass down-draft construction which, with integral oil-burner, accounts for the remarkable efficiency of Cleaver-Brooks steam generating equipment.

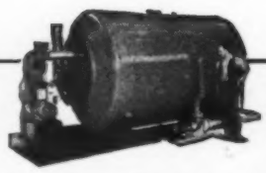
This construction doubles the lineal gas travel, compared to ordinary two-pass boilers,—the result is unmatched high heat transfer and efficiency.

No other equipment has this original and exclusive four-pass down-draft construction—plus the perfected positive dry coil method of condensate return—that's why you get hot, dry steam faster with less fuel and water with Cleaver-Brooks equipment. Write for bulletins and complete information.

CLEAVER-BROOKS COMPANY
***5106** N. 33rd Street • Milwaukee 9, Wisconsin*



Automatic Steam Plants
Completely self contained; highly efficient; require only simple piping connections to place in operation. Fully automatic fuel-oil burner; condensate recovery and feed water pumping system; no stack needed, sizes from 20 to 500 h.p.; pressures 15 to 200 lbs.



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Oil-fired; fully automatic or manual operation; no licensed engineer needed; two capacity sizes: 3000 gals. storage tank for 1600 gals. of water heated 150° F. per hour; 1500 gals. storage tank for 800 gals. of water heated 150° F. per hour.

Portable Pumping Boosters
Heats bituminous material by direct firing in one operation, loading directly to distributor, relay truck or returning to tank car. Two sizes, truck mounting or 4-wheel trailer.

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Available in 2 and 3 tank-car sizes. Oil-fired with exclusive four-pass flue travel; dry-coil steam condensate return under pressure — no water or heat loss. Provides a portable source of steam wherever needed.

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Each extra trip means that much more dirt moved! 2-cycle Diesel tractors gain those extra trips:

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BY requiring less time out for lubrication — you save ½-hour lubricating time every shift with the 200-hour truck wheels and idlers.

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Marmon-Herrington All-Wheel-Drive converted Ford operating in sands of West Texas Oil Fields.

SUPERLATIVE PERFORMANCE

On The Highway and Off

The many advantages of *All-Wheel-Drive* trucks for operation *off the highway and across country* have been demonstrated on hundreds of battle fields in the war. These are the trucks which have performed seemingly impossible feats, of transporting Allied soldiers and supplies, over the worst kinds of terrain.

The same qualities of design and performance, when Peace comes, will again be of inestimable value in road building and maintenance, oil, logging, mining and public utility services.

But *All-Wheel-Drive* is just as valuable *on the highway, too.* Marmon-Herrington *All-Wheel-Drive* converted Fords and Heavy Duty trucks reduce the hazards of sharp curves, steep grades and slippery roads in highway freight and passenger services. The greater safety, when all wheels grasp the road surface with live power and traction, permits faster schedules and lower operating costs. You may be able to get delivery earlier than you think. Let us submit further facts. Write for literature.

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THE toughest drainage problems —on highways, airports and railways, in big city sewage and water supply systems—have been solved by U·S·S American Welded Wire Fabric reinforced concrete pipe. It has the maximum strength and durability to combat the most treacherous soil and foundation conditions.

The ability of U·S·S American Welded Wire Fabric to aid in load distribution and to withstand heavy stress makes it first choice for strength, economy, efficiency and durability.

Prefabricated in rolls for easy handling, U·S·S American Welded Wire Fabric composed of high yield point cold drawn wires can be accurately placed and spaced in both single and double cage forms and holds its position during pipe construction.

All reinforced concrete pipe made by reputable manufacturers is built to A.S.T.M. standards. When the concrete pipe you use is reinforced with U·S·S American Welded Wire Fabric, it will give you long, efficient, economical and trouble-free service.

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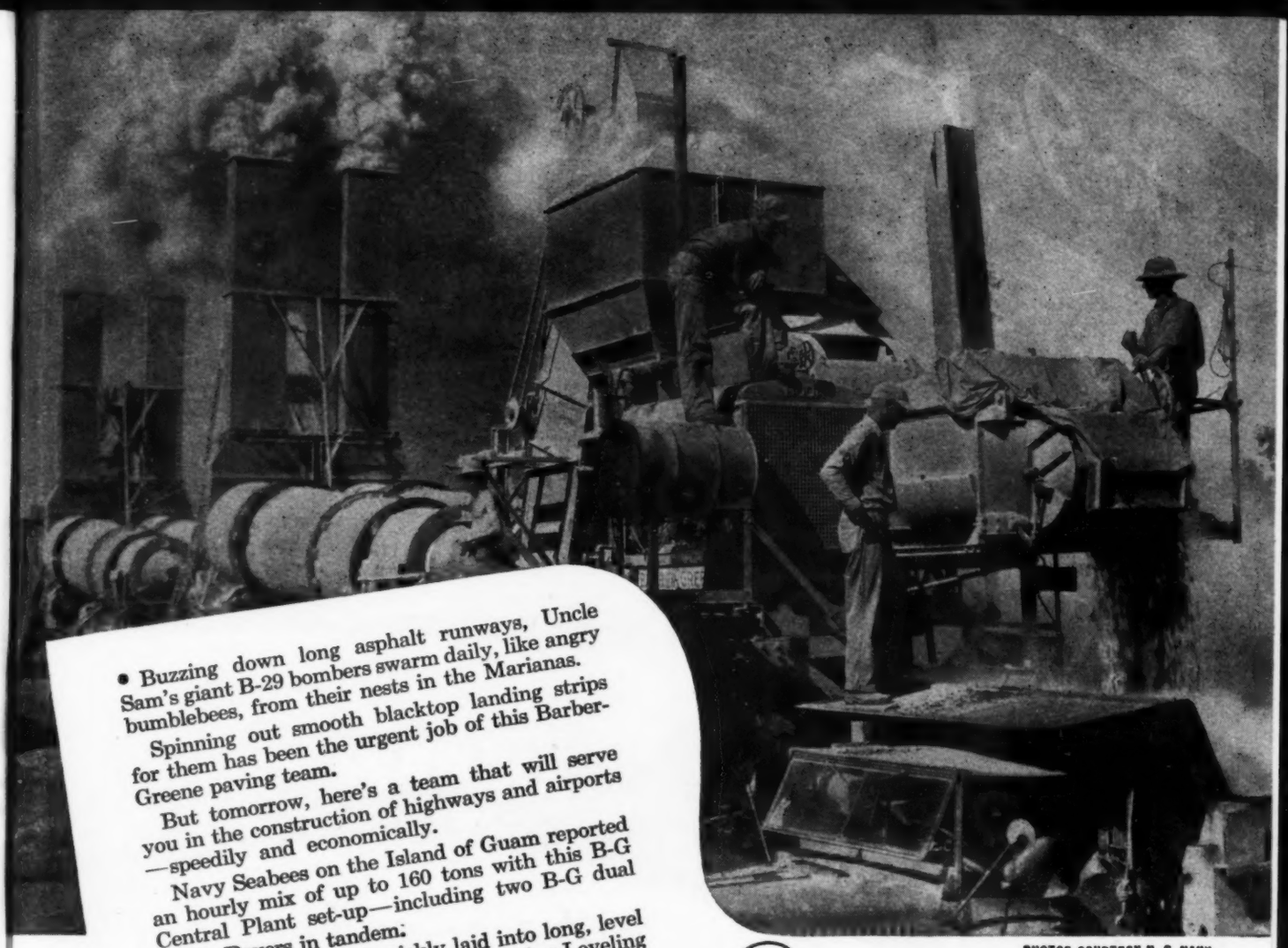
UNITED STATES STEEL

U·S·S American WELDED WIRE FABRIC



PHOTOS COURTESY U. S. NAVY

THE B G TEAM THAT BUILT A "B's" NEST

• Buzzing down long asphalt runways, Uncle Sam's giant B-29 bombers swarm daily, like angry bumblebees, from their nests in the Marianas.

Spinning out smooth blacktop landing strips for them has been the urgent job of this Barber-Greene paving team.

But tomorrow, here's a team that will serve you in the construction of highways and airports —speedily and economically.

Navy Seabees on the Island of Guam reported an hourly mix of up to 160 tons with this B-G Central Plant set-up—including two B-G dual Drum Dryers in tandem.

Mix produced was quickly laid into long, level taxiways with a modern B-G Tamping-Leveling Finisher.

When the time comes to begin the extensive highway and airport program, let Barber-Greene equipment help you. B-G equipment has established new standards in accuracy of proportioning and homogeneity of mix . . . has provided a method of putting down a firm, ripple-free mat efficiently. Moving and erection has been changed from a major project to a simple, low-cost maneuver. Barber-Greene Company, Aurora, Illinois.

45-4

Barber B G Greene

Constant Flow Equipment

the Job— SPREADING ROCK AT A PROFIT

the Equipment — AN ADNUN PAVER

THIS is the modern, profitable way to put down rock on highways and airports. Well over 100 tons an hour is an easy average with an Adnun while some owners report 190 tons per hour possible output. Of equal importance, is the fact that the rock is laid right to specifications, even courses free from voids and irregularities, accurate to a small fraction of an inch. No material is wasted and there's no need for raking or excessive hand labor.

The Continuous Course Correction feature, which is an exclusive Adnun feature, automatically eliminates hollows and bumps with each successive course. Lays any thickness, any width to any specification of Crown or Bank.

After you have spread the base, the same Adnun will put on the black top without making any changes in the machine. Get the facts on this versatile contractor's tool now and be ready to underbid any competition and still make good profits.

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ADNUN

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BLACK TOP PAVER

WITH CONTINUOUS COURSE CORRECTION

Why you should restore war-weary highways with Asphalt-resurfacing

1. **It can be laid right over existing surfaces at low cost**
2. **It utilizes easily available materials**
3. **Experienced contractors have equipment needed to speed up work**
4. **The job can be done quickly**
5. **There is less interruption to traffic**

Wartime neglect and wear on highways—heavily traveled, four-lane, trunk lines or secondary roads—can be quickly and economically restored to better-than-new condition with Asphalt-resurfacing.

Many states have already constructed miles of this smooth, easy riding, all-weather surfacing right over worn concrete, brick, or asphalt pavement. It will give years of service with the minimum of repairs. Methods of resurfacing used depend upon the type and condition of pavement. A concrete resurfacing job is briefly described here. Look into the possibilities of using Asphalt-resurfacing to bring your highways up to date and keep them that way at little cost.

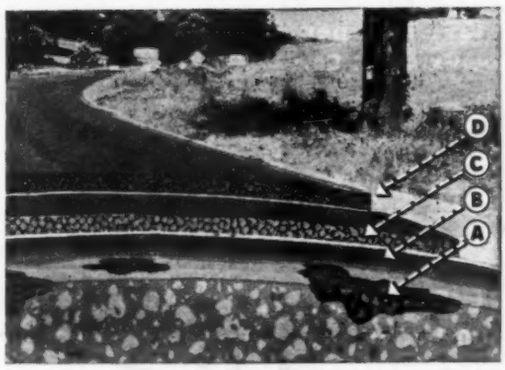
A Standard Asphalt Representative will be glad to give you details of methods and procedures followed by other highway departments in this work. Call the local Standard Oil Company (Indiana), or write 910 South Michigan Avenue, Chicago 80, Illinois.

One method of Asphalt-resurfacing

The cross-section on the illustration shows steps usually taken in asphalt-resurfacing.

A. *Spot Patching.* Where the old highway surface is badly broken, holes are patched by filling with the same mix as used in the binder course.

B. *Prime Coat.* A thin coat of cut-back asphalt, spread over the old road surface. When used, it helps to bind the asphalt to the old surface.



C. *Binder Course.* An asphalt-aggregate mix. It is delivered hot from the central mixing plant to an asphalt finishing machine.

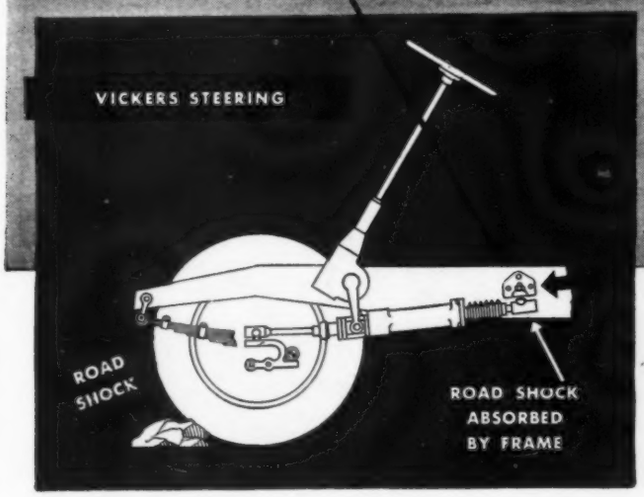
D. *Wearing Course.* This is the top course, composed of asphaltic concrete with somewhat finer aggregate than is used in the binder course. It is also hot mixed at the central mixing plant and laid by machine. This top course presents a smooth, water-proof, long-wearing surface which requires no seal coat or stone application.

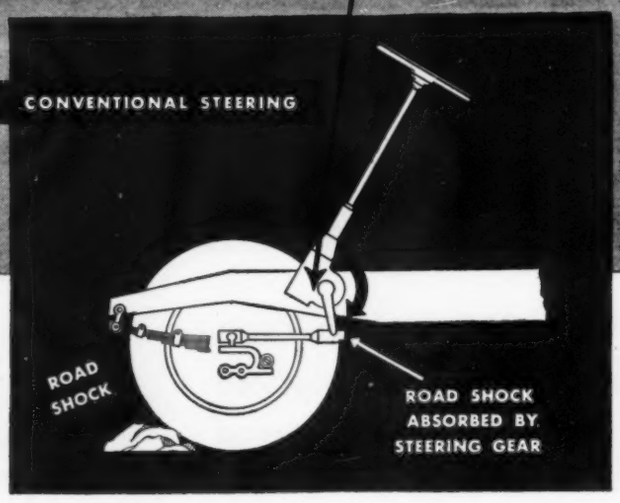
Buy more War Bonds

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

VICKERS Hydraulic POWER STEERING

Transmits Road Shock Thrusts to the *FRAME...instead of to the Steering Gear*





With Vickers Hydraulic Power Steering, no road shock can be transmitted to the steering gear and to the driver . . . road shock thrusts are transmitted to the frame. A vehicle can be driven over the curb, through sand, and on rough ground with no "fight" from the wheel. A flat tire will not cause swerving. A light touch on the steering wheel is sufficient at all times.

Among the many other important advantages of Vickers Hydraulic Power Steering are: greater driver efficiency by reducing fatigue to a minimum, easy application to existing chassis designs, automatic overload protection for both hydraulic system and steering linkage, and 15 years of successful operating experience on trucks, buses, road machinery, etc. Ask for Bulletin 44-30 which contains complete information about the Vickers Hydraulic Power Steering System.

VICKERS *Incorporated* **1432 OAKMAN BLVD. • DETROIT 32, MICH.**

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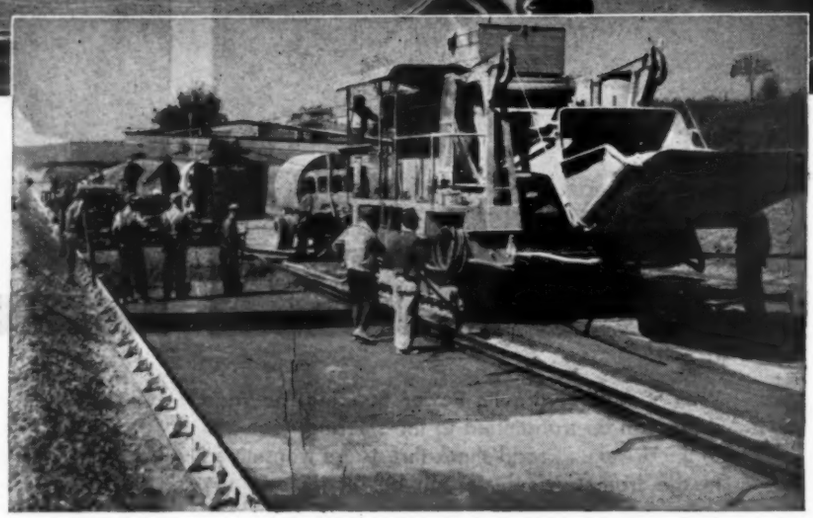
VICKERS Hydraulic POWER STEERING is Simple . . . Compact . . . Easily Installed



"YES SIR . . . 22 CECO OFFICES strategically located give speedy service to road builders everywhere!"

Nation wide service from 22 offices. That's only one advantage of the Ceco Highway Products Division service to road builders. Here's another . . . by specifying Ceco you can take care of your Highway product needs in one order, for Ceco provides a complete speedy service.

And remember, Ceco is the country's largest independent fabricator of bars . . . and that means experience in steel fabrication. Yes sir, when you specify Ceco you can be certain you're getting what it takes to do a better job, faster! Be sure to check the list of Ceco Highway Division products, then write for details. Do it now, well in advance of your post war construction!

Here ROADBUILDERS, is your Check List of CECO Highway Products . . .

1. Reinforcing steel
2. Welded fabric
3. Expansion and contraction joint: asphalt or fibre
4. Metal conterstrips
5. Load transmission devices
6. Cecure curing compound
7. Dowel bar supports, dowel sockets, stake pins
8. Subgrade paper

CECO STEEL PRODUCTS CORPORATION

***Highway Products Division*—5701 W. 26th St., Chicago, Ill.**

Manufacturing Division, Concrete Engineering Division, Sheet Steel and Wire Division

ENGINEERING MAKES THE BIG DIFFERENCE IN CECO CONSTRUCTION PRODUCTS

SURFACE SMOOTHNESS *is its business*

Engineered from the ground up for precision operation, the Austin-Western Tandem Roller with its—

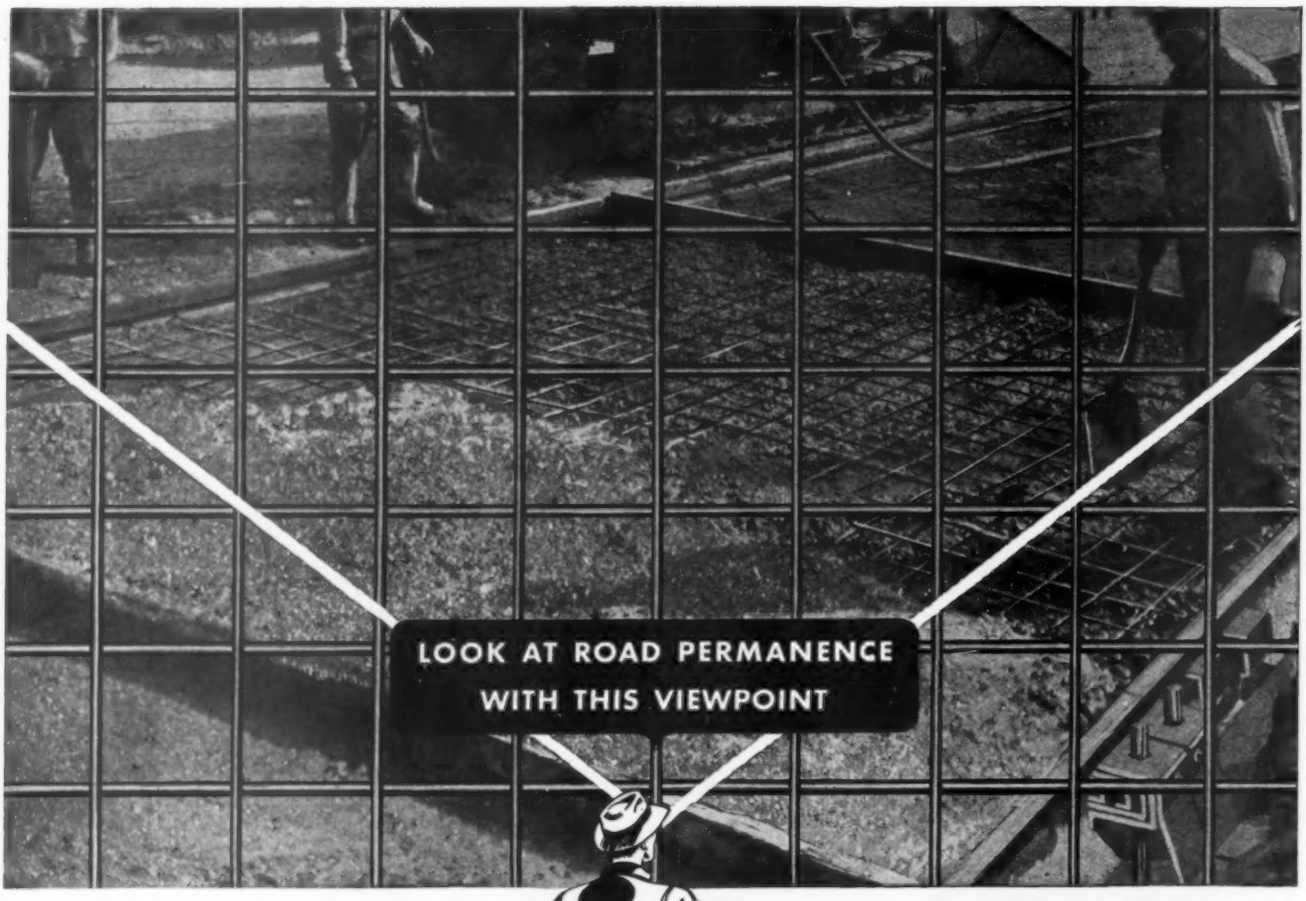
Variable Weight **Rigid Box Frame**
Smooth Power **Hydraulic Steer**
More Visibility **Less Overhang**
More Clearance
Convenient Single or Dual Controls

performs in a manner that meets all specifications for high-type surfaces.

The Austin-Western Line also includes 3-Wheeled Rollers. Catalogs are yours for the asking.

AUSTIN-WESTERN COMPANY,
AURORA, ILLINOIS

BUILDERS OF ROAD MACHINERY
Austin-Western
SINCE 1859
BUY MORE WAR BONDS



Truscon Welded Steel Fabric Helps Build the BEST ROADS!

Safeguard public funds in the highways which you plan . . . assure long-lived, full-value highway construction . . . by depending upon Truscon Steel Fabric for road protection.

Here's what Truscon Welded Steel Fabric assures:

Provides resistance to cracking due to shrinkage of concrete during setting period.

Provides tensile strength necessary to resist subgrade friction.

Provides increased resistance to cracking in concrete slabs, which has been created by the expansion and contraction of subgrades.

Provides increased resistance to cracking of concrete due to load.

Prevents the development of microscopic cracks into visible cracks.

Prevents cracks from opening and allowing entrance of water.

Prevents broken ends of slabs from separating at a crack.

Decreases spalling and progressive breakage.

All these, and other advantages, will help build more wear-life into public highways with Truscon Welded Steel Fabric Reinforcement and associated roadbuilding products.

TRUSCON
Steel Company

SUBSIDIARY OF REPUBLIC STEEL CORPORATION • YOUNGSTOWN 1, OHIO

BIG *all the way through*

When you see the *new* Ward LaFrance commercial models, you'll be looking at something new in transportation . . . the toughest, sturdiest job on the highway. It's the "civilian" version of the great M1A1 Heavy Wrecker we have been turning out in volume for the Army, developed to be the last word in rugged truck performance . . . The new Ward LaFrance heavy-duty trucks are "built big" not only in rated capacity, but all the way through.

. . . If your fleet suffers from the usual profit-eating toll of axle failures, broken springs, burned clutches, the new Ward LaFrance is the common-sense answer to more dependable, lower-cost hauling. This stamina comes from a basic engineering principle of providing strength, more than sufficient for your requirements. Ward LaFrance has evolved a sales plan of unusual interest, which you should investigate. Write to our Sales Department today for details.

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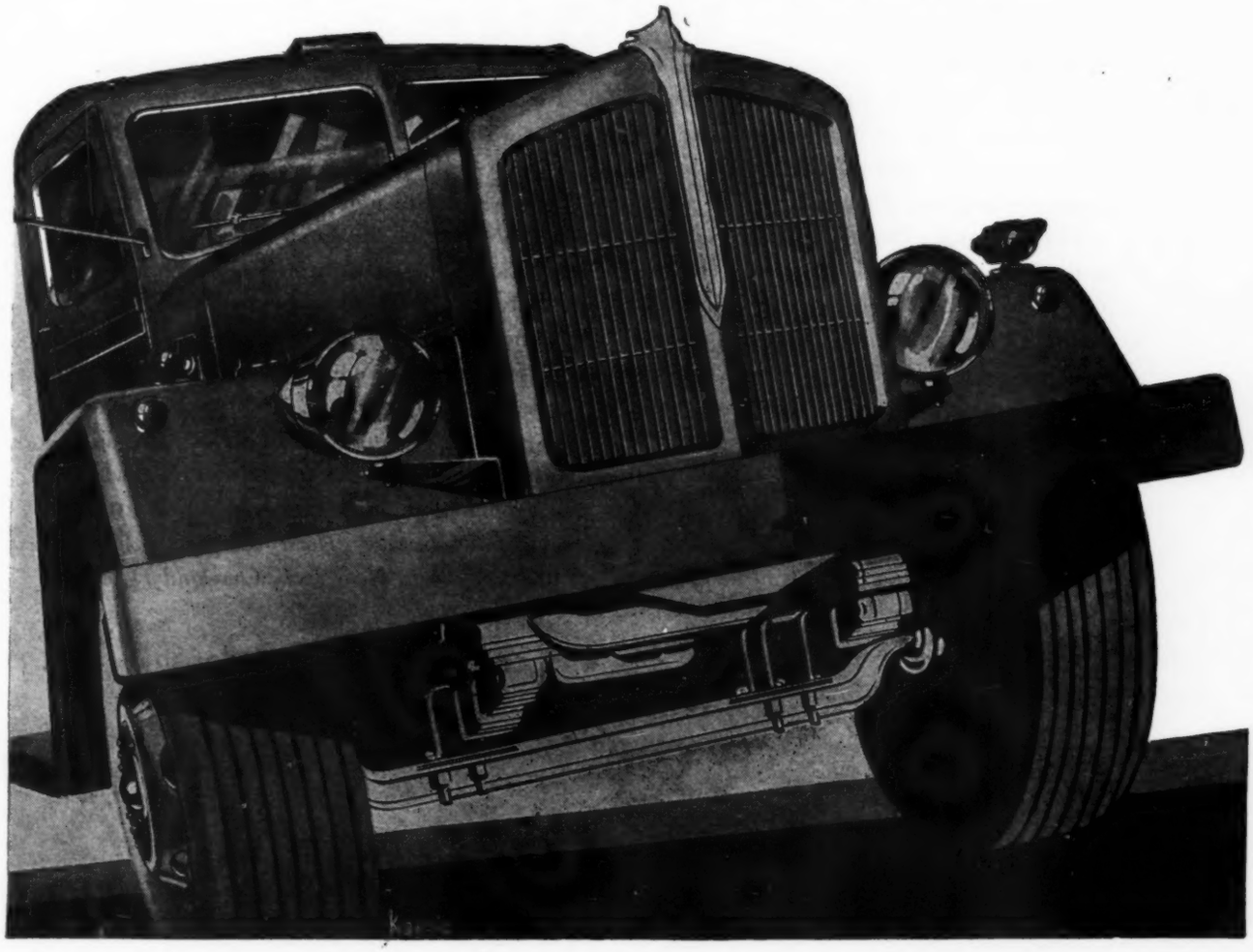
WARD LAFRANCE

TRUCK DIVISION

GREAT AMERICAN INDUSTRIES, INC., ELMIRA, NEW YORK



Here a new science attacks an old problem

Cylinders in engines usually get a pretty raw deal. They have to take more grueling punishment than any other part of the engine. They . . . and the rings . . . bear the brunt of the blame when engines lose power.

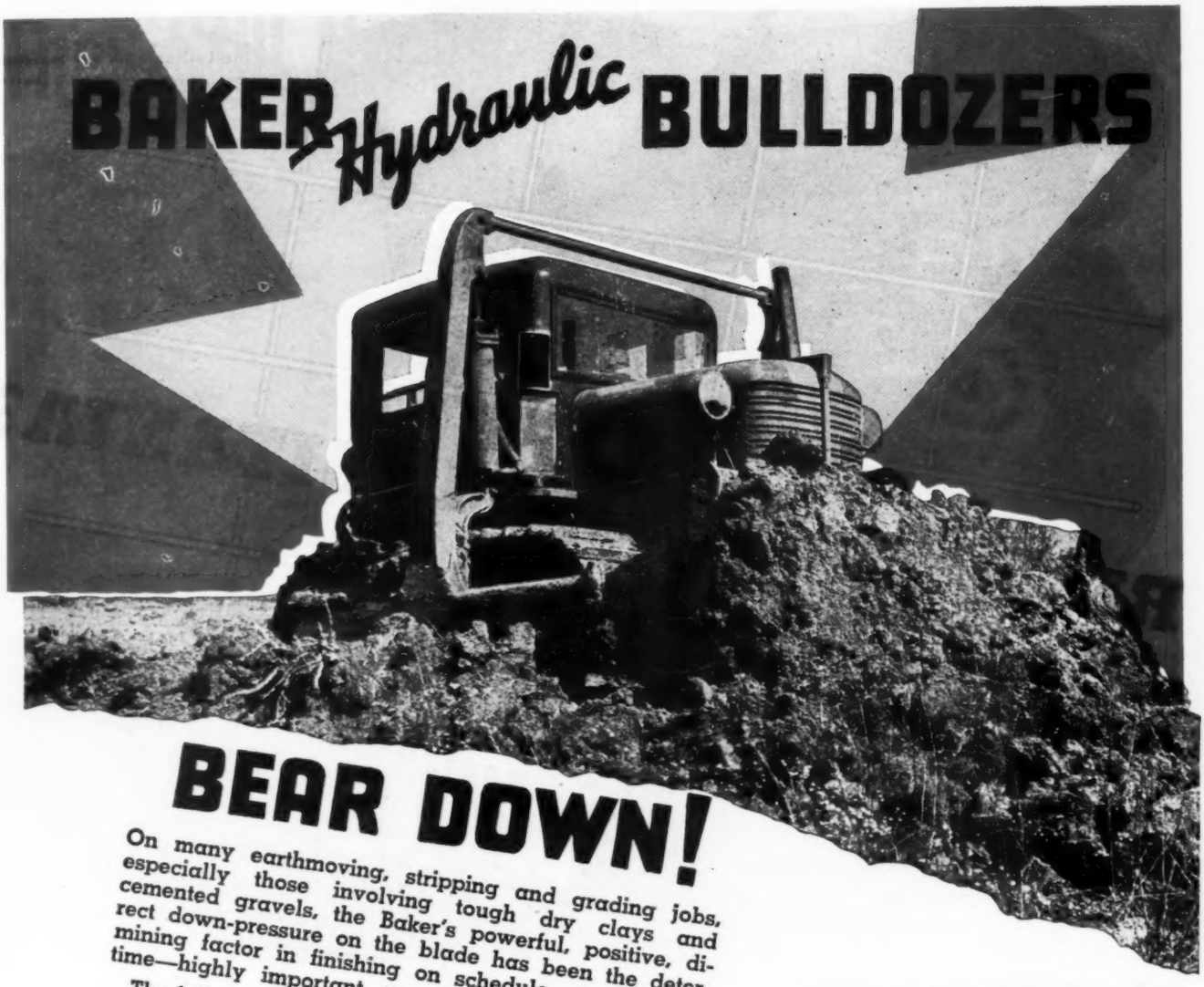
Here, in the Van der Horst Research and Engine Testing Laboratories, we are continuously attacking this old problem of wear. The new science of PORUS-KROME processing is attuned to the needs of the various types of engines. Tests are run in several types of engines to determine the degree and type of porosity which will give the maximum wear resistance. Every development or change in PORUS-KROME processing is forthwith scrutinized by the "Lord High Inspector" . . . *the engine.*

Let's work out *together* a square deal for *your* cylinders. Our engineers will gladly develop with your engineers the specifications which will multiply cylinder life 4 to 20 times . . . ring life 3 to 5 times. The entire facilities of these laboratories are committed to solving the problem of cylinder wear for engine manufacturers.

Even though building of engines for general use is still restricted, it is none too soon to plan for the use of PORUS-KROME in postwar engines. A request from you will bring complete information about PORUS-KROME. *Van der Horst Corporation of America, Olean, New York, Cleveland 11, O.*

PORUS - KROME . . . *Good for the Life of your Engines*

BAKER *Hydraulic* BULLDOZERS



BEAR DOWN!

On many earthmoving, stripping and grading jobs, especially those involving tough dry clays and cemented gravels, the Baker's powerful, positive, direct down-pressure on the blade has been the determining factor in finishing on schedule—or ahead of time—highly important on war construction jobs.

The full weight of the tractor front end can be brought to bear on the blade forcing it to cut in—the operator need not depend upon the weight of the blade or gravity to force it into a cut.

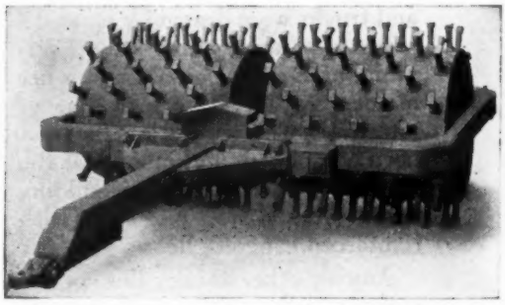
Baker hydraulics offer all the other desirable features —fast reaction, high moldboard lift, all-weather operation, ease of maintenance (what little is needed).

Why not figure on having Baker *hydraulic* Bulldozers "bear down" on your postwar jobs?

THE BAKER MFG. CO.
506 Stanford Ave., Springfield, Ill.
If it concerns Victory, it concerns us!

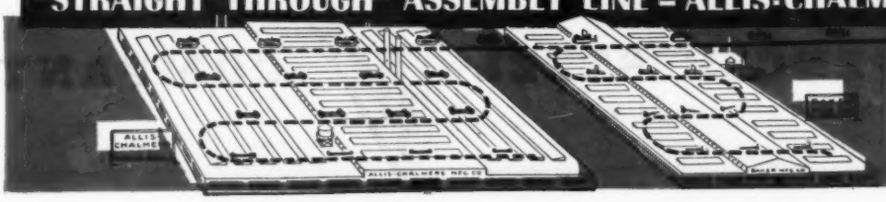
BAKER
They Go Together
A-C

BAKER SHEEPSFOOT TAMPING ROLLERS

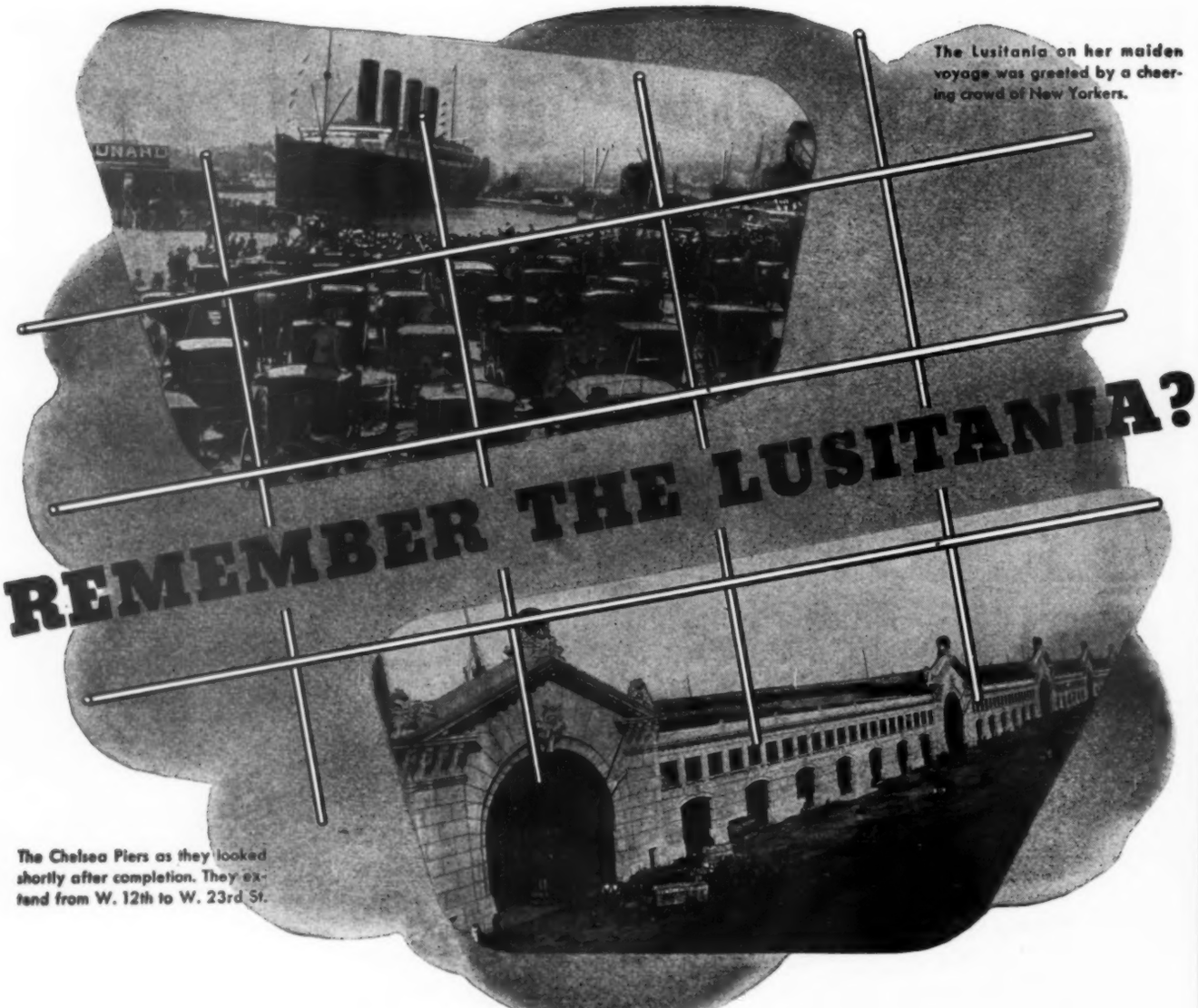


- **Full oscillating rollers that follow contour of ground.**
- **Rugged frame and rollers that withstand abuse.**
- **Tamping feet have replaceable weld-on toes.**

"STRAIGHT THROUGH" ASSEMBLY LINE – ALLIS-CHALMERS TO BAKER TO YOU!



The modern Baker plant with its completely equipped fabricating, machining and blacksmithing shops adjoins the Allis-Chalmers crawler tractor plant. When you order an A-C tractor with Baker bulldozer or gradebuilder, your tractor leaves the A-C assembly line, crosses a narrow court and goes on the



The Lusitania on her maiden voyage was greeted by a cheering crowd of New Yorkers.

REMEMBER THE LUSITANIA?

The Chelsea Piers as they looked shortly after completion. They extend from W. 12th to W. 23rd St.

In September 1907, when carriages and trucks were drawn by horses, a proud new luxury liner, the Lusitania, arrived in New York on her maiden voyage. Her pier, one of nine in the Chelsea section, had just been completed, and in August the contract had been let for building double-decked steel pier sheds with reinforced concrete floors.

Among other things the specifications called for reinforcement with "No. 4 gauge 2 inch center Clinton Wire Cloth." Then on the market for only five years, 800,000 sq. ft. of Clinton Fabric were used in what engineers described as "probably the highest type of pier building attempted in this country."

During their 37 years of punishing service, including the terrific demands of two World Wars, the Chelsea Piers have handled their full share of heavy freight and withstood exposure to extreme changes in temperature. In these famous piers, as in thousands of structures, streets and sewers, Clinton Electrically Welded Fabric provides added strength and endurance to concrete, with a minimum of maintenance.

The uniformity and high performance standards of Clinton Welded Fabric has made it the choice of many leading architects and engineers.

Try it on your next concrete reinforcement job.

WICKWIRE SPENCER STEEL COMPANY

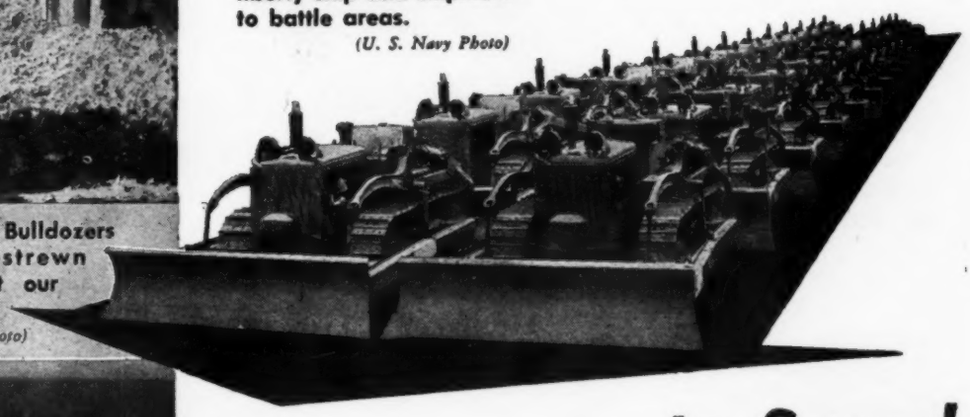
500 FIFTH AVENUE, NEW YORK (18), N. Y.

ABILENE • BOSTON • BUFFALO • CHATTANOOGA • CHICAGO • CLINTON (MASS.) • DETROIT • HOUSTON • LOS ANGELES
PHILADELPHIA • SAN FRANCISCO • TULSA • WORCESTER

They Still Need Plenty of THESE

FRANCE — Bullgraders and Bulldozers help clear many rubble-strewn streets like this to permit our forces to roll forward.
(Signal Corps Photo)

This line-up of Bullgraders was massed on a dock for loading to a liberty ship and shipment to battle areas.
(U. S. Navy Photo)



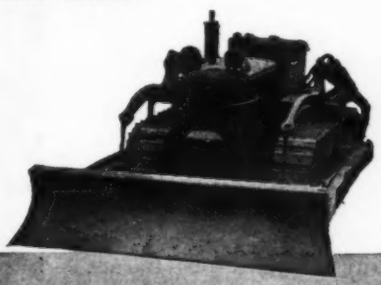
SOUTH PACIFIC — It takes batteries of Bullgraders to convert an island into an airstrip. Almost all of this island was cleared for taxiways and revetments.
(U. S. Army Air Forces Photo)

SICILY — Reconstructing a blasted bridge. In Sicily and more recently in Italy, scenes like this mean more and more work for blade equipment.
(Signal Corps Photo)

. . . to Speed the Biggest Job of All!

With every Allied advance, an already huge earth-moving task becomes enormous . . . and the need for Bullgraders and Bulldozers in wholesale lots continues to be acute. Bucyrus-Eries en masse, like the array above, are still streaming to the fronts . . . where they're needed most!

NBB

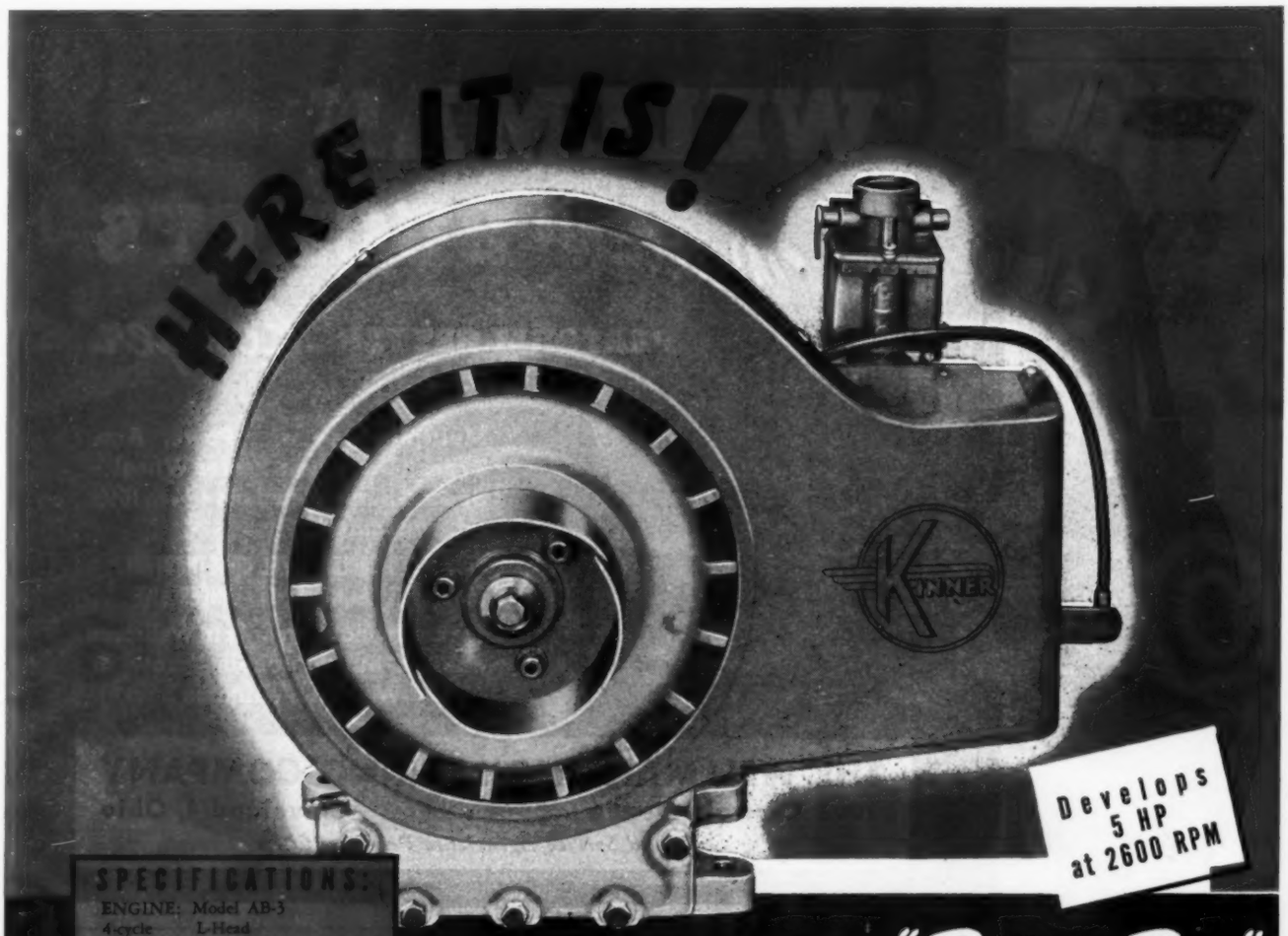


Because the armed forces are claiming almost all of our current production, only a very limited number of machines is available for high priority civilian operations. See your International TracTracTor Distributor for information on new machines, rentals, or service; let him help you with your plans for modernizing your equipment at Victory.

BUCYRUS-ERIE CO., So. MILWAUKEE, WIS.

BUCYRUS ERIE TRACTOR EQUIPMENT

SEE YOUR INTERNATIONAL TRACTRACTOR DISTRIBUTOR



THE REVOLUTIONARY "Busy Bee"

SPECIFICATIONS:
ENGINE: Model AB-3
4-cycle L-Head
HORSEPOWER: 5 BHP, at 2600 rpm.
CYLINDERS: one, horizontal, detachable
BORE: 2¾ Inches
STROKE: 3 Inches
PISTON DISPLACEMENT: 17.8 Cu. Inches
COMPRESSION RATIO: 5.4 to 1
FUEL: 70 Octane fuel or better
COOLING: Air from Flywheel Fan
LUBRICATION: Full pressure from oil pump to all bearings. Wet sump of 2½ pints capacity.
IGNITION: High Tension Flywheel Magneto
STARTING: Rope
GOVERNOR: Air Type
CARBURETOR: Down draft with Maze type air cleaner
WEIGHT: 75 lbs.
SPACE OCCUPIED: 2.4 Cu. Feet. Height 15 Inches, width 18 inches, length 15-7/16 Inches
CRANKSHAFT: Steel with hardened and ground journals. Dynamically balanced.
CONNECTING ROD: Dural forging, heat treated.
PISTON: Aluminum alloy, heat treated
PISTON PIN: Steel, hardened and ground—¾ Inches diameter
CAM SHAFT: Cams hardened and ground
VALVE SEAT INSERTS: Two, of hardened steel.
HEAD: Aluminum alloy, heat treated.
CRANKCASE AND REAR COVER: Aluminum alloy, heat treated.
VALVES: Two, 1-15/32 Inches dia.
COMPRESSION RINGS: Two of 1/16 Inches width
OIL CONTROL RING: One of 3/32 Inches width
CONNECTING ROD, LENGTH: 6 Inches
POWER TAKE-OFF SHAFT: 1 Inch. Rotation is counter clockwise facing shaft.
SPARK PLUG: 14MM

HIGH PERFORMANCE LOW COST
RUGGED LIGHT COMPACT

The revolutionary "Busy Bee" engine by Kinner embodies principles which are new as applied to small engine design and manufacturing. Daring in design and engineering, it has these unique features:

- Rated at 5 HP, it actually develops 6 at 3250 rpm.
- Aircooled, 4-cycle, L-Head.
- Horizontal cylinder, detachable—easily replaced.
- Simple, clean design makes maintenance easy.
- Light metal alloys make it lightest engine in its horsepower class—very advantageous for portable units.
- Aluminum head, piston and crankcase materially improve cooling characteristics.
- Full pressure lubrication to all bearings.
- Flat torque curve—the "Busy Bee" will "lug" under heavy loads.
- All bearing surfaces hardened—for longer life.
- Bearings large—bearing pressures low.

The Kinner "Busy Bee" is built for universal service under all conditions. Write on your letterhead for illustrated brochure, engineering data. KINNER MOTORS, INC., GLENDALE 4, CALIFORNIA.

Kinner

1919 · 1945 ENGINE BUILDERS FOR OVER A QUARTER CENTURY

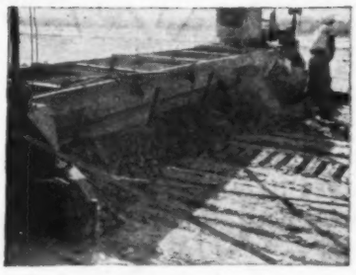
For Complete Facts

send for this folder

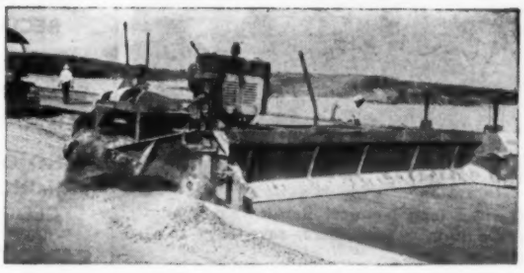
The many unique features embodied in the new Standard-Lewis Subgrader come as a result of design by practical paving equipment engineers. These men know well the problems encountered and have built into this machine many practical improvements that save contractors, time, labor and money.

The new Standard Steel 8-page folder covers in detail all information relating to the efficient operation and economy provided by this ingenious Subgrader.

A request on your letterhead will bring a copy promptly.



This is an example of deep cutting into tough material—gravel as large as 14" in diameter is handled with ease.



No chipped or broken edges of concrete pavement is experienced with the solid rubber tired wheels you can use on the STANDARD-LEWIS Subgrader.

OTHER STANDARD PRODUCTS

ASPHALT AND CONCRETE FINISHERS
TANDEM ROLLERS
TOW BROOMS
BINS AND BATCHERS
CONCRETE SPREADERS

STANDARD STEEL CORPORATION

General Offices and Plant: 5001 South Boyle Avenue
Los Angeles 11, California

ASPHALT - AGGREGATE ADHESION AS ALTERED BY CHEMICAL ADMIXTURE

Case No. 4

*** DRENCHED AGGREGATE COATS PERFECTLY**

"Drenched aggregate was mixed with asphalt that had been treated with 0.5% **NOSTRIP Compound,** oil formula. For all the aggregates, (Quartzite, Diorite, Dolomite, Granite, Traprock, Gravel and Amphibolite), there was not the slightest bit of trouble to obtain a **perfect coating** of asphalt."

*Above is an excerpt from the report of the Testing Engineer of the Department of Highways of a Southern State. Send for copy of official report, giving name of State and results of all of the NOSTRIP tests made there.

THE ALL-YEAR ROAD MATERIAL

NOSTRIP

AN ADMIXTURE FOR TAR AND ASPHALT

MAGUIRE INDUSTRIES, INCORPORATED • NOSTRIP DIVISION • 122 E. 42nd ST. NEW YORK, 17, N.Y.

TILL THE JAPS SAY "UNCLE"

AMERICA bounced back hard in this war against the Japs, and the boys who led the rebound were *United States Marines.*

Ever since Guadalcanal the Marines have proved that boys from Kokomo, the Ozarks and the Bronx—when steeped in Marine Tradition, skilled with Marine training—are doggone good fighters. On beachhead after beachhead—then in jungle after jungle—they were far outnumbered by the Japs. But not outfought!

On they go, those Marines, on land and sea and in the air . . . outsmarting, outshooting, outkilling the enemy—till the Japs say "Uncle."

They have good equipment, sure. Most of the thousands of trucks they use, for example, are Internationals. And most of the thousands of bulldozing tractors they use are Internationals, too. Trucks and tractors—vital weapons in this grim, modern war!

But proud as we are that Harvester has been able to make equipment rugged enough to fight with the Marines, we know that the real fighting machine in this march to Tokyo is the Marine himself. What a machine! All speeds forward . . . none reverse. Tough . . . rugged . . . smart. A superlative fighter. A superb citizen.

We proudly salute those boys from Kokomo, the Ozarks and the Bronx, who are *fighting* up to their glorious motto —Semper Fidelis.

INTERNATIONAL HARVESTER COMPANY
180 N. Michigan Ave. Chicago 1, Illinois

WHERE THE MARINES FOUGHT

From Guadalcanal the Marines started marching in giant strides toward Tokyo—sweeping clean the stepping stones to Victory.

The Russell Islands, Segi Point, Viru Harbor, Rendova, Vangunu, Rice Anchorage, Enogai Point, Munda, Vella Lavella, Choiseul, Empress Augusta Bay.

On to Tarawa, the island that the Japs said couldn't be taken.

Cape Gloucester. Then Majuro, first pre-war Jap territory to fall to U. S. fighters. Roi, Namur, and other islands in the Kwajalein atoll.

Eniwetok atoll. The Marianas —Saipan, Guam, Tinian. Peleliu, in the Palau Islands. Iwo. Okinawa. Closer . . . closer to Tokyo.

INTERNATIONAL HARVESTER

Power for Victory . . . Power for Peace

HOW *"Riding Comfort"* Saves Money in Material Handling

All heavy machines are more efficient and cost less to run when they are free from clutch troubles.

The Fawick Airflex Clutch gives them new smoothness, new freedom from vibration, by operating through a cushion of air and rubber, as effective as the cushion of air and rubber that gives the motor vehicle comfort and longer life.

With this clutch, no springs, arms or toggles are needed. There are no adjustments to make—no lubrication required. Maintenance costs are low. Even misalignment is corrected automatically.

By controlling inflation, clutch engagement is as light or as firm as the job demands. And there is complete nonmetallic safety for both drive and driven members.

Let our engineering department give you the benefit of their broad experience in the form of definite recommendations for your machines.

• •

The Fawick Clutch provides air-cushion clutch action because it matches today's fine motor vehicle tires in quality of materials and excellence of workmanship—the result of the great technical advances made by America's Rubber Industry.

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FAWICK *Airflex* CLUTCH

POWER CONTROLLED BY AIR

ROADS AND STREETS

June, 1945, Vol. 88, No. 6

Recent Trends in Asphalt Paving

This clear, authoritative review was presented at the 1945 Annual Highway Short Course at Texas A. & M. College, Bryan

By THOMAS C. DAVIS

Asphalt Paving Engineer, Texas Highway Department, Austin

DEVELOPMENTS in asphalt paving practices have been, as with most other construction practices, a slow evolution by trial and error. Occasionally a more venturesome soul will try a new method or a new material and if he is successful, others will slowly begin to use the method or material. Sometimes circumstances such as a war or other emergency will speed the pace of progress but as a general rule this pace is slow and can be measured in inches rather than in miles.

Some of the more recent developments or trends in asphalt paving practices are:

1. Use of softer, higher penetration asphalts.
2. Use of local aggregates.
3. Use of hot mix to a greater extent.
4. Use and developments of spreading machines.
5. Use of cold mixes for light surfaces rather than inverted penetration.
6. Use of the drag seal in the place of the penetration seal.
7. Use of better design methods.

Softer Asphalts Used

1. The use of softer, higher penetration asphalts, particularly in plant mixes, seems to be an almost universal trend. The southeastern states use 85-100 asphalt cement in sand-asphalt bases and surfaces, 120-150 in asphaltic concretes and an RC2 or RC3 made from 85-100 asphalt in cold mixes and drag seals. Alabama has used 230 in asphaltic concrete, Mississippi engineers used 70-80 penetration in most of their sand asphalts; however, they used 85-100 in one of the last jobs and liked it very much.

North Carolina used 50-60 penetration in the first sand-asphalt jobs but changed to 85-100 in 1935 and has used it since. Most of the midwestern and western states use 85-100 or 120-150 in asphaltic concrete. The Army, Navy and CAA have used 120-150 in most of the asphaltic concrete used in airport runways and camp streets. Even the conservative northeastern states have used 60-70 and 85-100 in a few projects.

The Texas Highway Department has used no asphalt harder than 85-100 penetration in the last six years. On about two-thirds of the hot-mix projects constructed in west Texas during the past three years 200-300 asphalt was used; 120-150 was used in the remainder; 120-150 has been used around Dallas, 85-100 on extremely heavy traffic roads around Houston, and 120-150 on other south Texas projects. Most penetration work uses 230

Hot-mix project (1944) on state route 117 near Borger, Texas—part of 112 miles of such work completed last year in the Amarillo district. One of 6 hot-mix contracts held by Public Construction Co., of Denton, Texas. The roller in the foreground is a gas-powered unit converted from steam

The contract at Borger consisted of 1 mi. of new asphaltic macadam and sand-gravel base (Bell & Braden, Amarillo, grading contractor), and 13 mi. of hot-mix resurface

asphalt and most of the RC2 used is made from 120-150 or 150-200 penetration asphalt cement.

Material Traditions Broken

2. One of the most remarkable developments in asphalt pavements in recent years has been in the use of local aggregates which not long ago were considered unsatisfactory for use with asphalt, particularly in hot-mix asphaltic concrete.

For instance, how many of you would have thought five years ago that an asphalt pavement could have been built out of caliche? Yet the Army has built several very satisfactory airports in New Mexico in which caliche was used as the aggregate in hot-mix asphaltic concrete. Runways at the Tyler and Longview airports were paved with hot-mix using iron ore top soil as the aggregate. Streets and airport at Conroe were paved with the same material.

Many miles of satisfactory roads have been paved in North Carolina, South Carolina, Alabama, Florida, and Mississippi using local sands in both hot and cold mixes. North Carolina is leveling up and resurfacing most of its old concrete pavements with hot mix sand asphalt. At one time Ohio required crushed aggregate for asphaltic concrete. In the Ohio River area they have plenty of fine gravel and sand and have learned how to make satisfactory asphalt pavements with them.

Most of the very heavy traffic highway between Cincinnati and Portsmouth has been resurfaced with 2 in. of hot mix in which this pea gravel was used as the aggregate. Resurfacing was done in sections varying in age from one to nine years, all of which were in very satisfactory condition last December.

We have just completed a project on U. S. 90, near Katy, in Harris County, Texas, in which an old asphalt surfaced gravel and stone base was widened and resurfaced with hot-mix in which iron ore top soil, local sand, and a mixture of clean oyster shell and local sand was used as aggregate. We have recently let a contract on U. S. 69 in Hunt County where an old asphalt surfaced stone base road is to be leveled up and widened with hot-mix local sand and surfaced with a mixture of the local sand and coarse sand or stone screenings.

More Hot-Mix

3. There seems to be a definite trend to hot-mix pavements and away from cold mix and heavy surface treatments or asphalt macadams. One reason for this is that the weather hazard is not as serious with hot-mix as with the other types. Another is that pavements are being built thicker and wider and require more tonnage; plants are being built more portable and consequently the ton cost for plant move-in and set-up is becoming less.

Still another reason is that, particularly during the past four years, most states have been engaged in an extensive program of leveling and resurfacing old pavements rather than the building of new projects. As most resurfacing projects are built under traffic, hot-mix, because it interferes with traffic to such a small extent and can be used very soon after being laid, is well adapted for this purpose. Hot mixes are generally more durable than cold mixes because it is possible to use more asphalt in them.

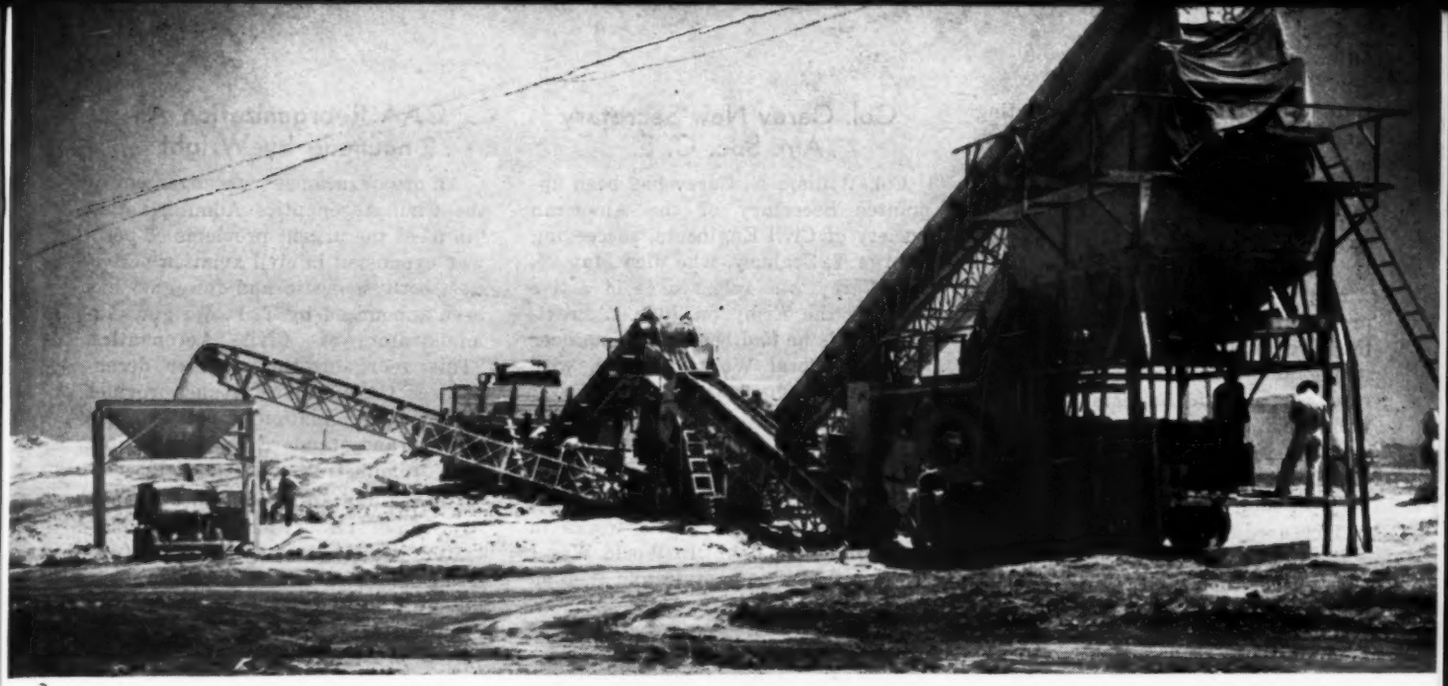
The trend seems to be away from cold mixes, either central plant, traveling plant, or road mix, for asphalt bases in parts of the country where the annual rainfall is more than 25 in. This is because of the difficulty in getting a job properly mixed, compacted and dried in one construction season. The construction season is much longer with hot-mix than with cold-mix.

Better Spreaders Available

4. Development of the spreading machine for asphalt mixes that do not require forms for support, grade, or alignment, have almost eliminated the necessity and use of forms. These machines spread the materials in lanes 6 to 12 ft. in width and can be so controlled that the material can be laid to an established grade line as in leveling work or to a uniform depth as in surface courses.

Spreading machines are not suitable for spreading cold mixes such as cut-back asphaltic concretes that require aeration. These mixes are usually aerated and spread with motor graders or some type of multi-blade drag. Motor graders are being used

(Left): The 26-ft. roadway was paved in strips 8, 10 and 8 ft. wide typical of west Texas practice. The resurface consisted of one 1¼-in. course of asphaltic concrete rolled to 93% or better density using an 8-ton tandem and a 10-ton 3-wheel roller. The frost-damaged asphalt penetration surface had previously been patched and shot with 0.3 gal. RC2. (Right): A Public Const. Co.'s hot-mix plant, also assembled from shop-made items and standard equipment. The modern semi-portable diesel power plant in the foreground operated the blower and a similar unit powered the dryer



Wartime parts and equipment shortages still hampered many Texas contractors in the winter of 1943-44, but not W. M. Jagoe of Public Construction Co., Denton, Texas. His unusual flair for improvising equipment is shown in the aggregate plant used in 1944 on 14-mile hot-mix job near Borger, and other Panhandle contracts.

The plant, pictured in the accompanying photograph, was originally designed for use as a 300 yd. per hr. producer of flexible base aggregate. All conveyors, feeders, dumping hopper and in fact everything except one primary crusher, one set of rolls, and one screen were made in the contractor's shop out of salvage or shop-made parts and odd structural material. An old steam engine was robbed to get an eccentric feeder, a carload of structural steel went into the fabrication of the conveyors.

As set up for the 1 mile of sand-gravel base and 14 miles of hot mix on Rt. 117, gravel from a nearby shovel pit was trucked to a dumping ramp at the far end, dumped into a cropper and carried up the first belt to a primary crusher. From here part of the material went into a lateral conveyor and loading bin, for use in sand-gravel base and for shoulder material. The remainder passed up a second in-line conveyor to the two-compartment bin nearest the camera. Here a screen caught oversize which was returned down a steep bucket ladder to a set of rolls, then returned to the primary crusher

to an increasing extent in spreading hot mixes used as leveling courses.

Cold Mix vs. Penetration

5. There seems to be a rather definite trend to use cold mix for thin surfaces in the place of penetration surface treatments. These cold mixes are generally prepared in mixing plants and often shipped considerable distances. Some road mixing is still being done but not to the extent of several years back. Cold mixes when properly prepared and laid do not bleed and consequently do not require as much immediate maintenance as penetration surfaces and do not become slick as penetration does in certain sections of the country.

Lots of Drag Sealing

6. The use of what is commonly called a drag seal in place of penetration seal is becoming more and more common practice in the southern and southeastern states and to a lesser extent in other parts of the country. The drag seal has the advantage of not bleeding, and it makes a more non-skid surface than the penetration seal.

However, it makes a rather open surface, is liable to ravel under freezing and thawing conditions and consequently is not used to as great an extent where these conditions prevail. Penetration seals are not as liable to become slick in the western part of the United States as in the eastern and southern parts.

Better Mix Control

7. One of the most marked improvements in the asphalt field has been in the design and control of asphalt mixes. Improvement in laboratory equipment and technique in the past few years has been such that the designing of an asphaltic concrete is fast becoming a science rather than an art.

Several states have devised stability tests which have proved satisfactory with their aggregates and conditions. One, the Hveems Test, seems to have good possibilities for universal adoption. Several methods have been devised and used from which it is possible to anticipate the final density of the mixture on the road from specimens moulded in the laboratory.

The use of these methods and equipment has disproved the old theory that it is necessary to use hard asphalt cement and certain rigid standard grading requirements to make a satisfactory asphaltic mixture.

Better Cold-Mix Needed

There is a need for a cold-mix material that is better adapted to maintenance patching. Cut-back asphaltic concrete because of the necessity for aeration is not as good for this purpose as for larger projects where it can be properly aerated. It does not remain workable very long in stockpiles and is practically unworkable in cold weather. A cold-mix developed by the Dallas District composed of limestone rock asphalt screenings, crushed stone and a heavy road oil, RO3 (Mod.), is well adapted for this particular type of work and is recommended for more universal use. It does not need aeration, stockpiles good, and is fairly workable in cold weather. Hot mix is best for patching of heavy-traffic city streets.

What of Heavier Loads?

There is continuous agitation to increase the truck load limit. This, in

On the Highway 117 job—G. A. Preston, supt. and firm member, Pub. Const. Co.; Guy Lott, Amarillo dist. highway engineer; H. W. Schmidt, resident engr.

spite of the fact that trucks operating under the present load limits are tearing up many of our pavements. This damage is more prevalent in what have previously been termed high type pavements than in some of our low type roads.

Maybe this increase of loads is progress. Its proponents so claim and they are, at the least valuation, a very strong and active minority. At any rate, we, as road builders, are faced with the fact that many of our present pavements are inadequate to carry the loads now using them, and it is very probable the legal load limits will be increased from time to time.

It seems to me that to satisfactorily meet future conditions, many of which are unknown, the roads now being planned or constructed should not only be built stronger but out of such materials that they can be widened and strengthened without loss of original investment. This strengthening process should start with the foundation —the embankments, the cuts, the subgrade—and extend upward rather than as we have done too often in the past, build a high priced pavement on a poorly constructed fill, through a poorly drained and seepy cut or on a plastic clay subgrade and expect it to stand the incessant pounding of heavy loaded trucks.

We often hear the phrase, "That's a good old concrete pavement," or "That's a good old asphalt road," when what should be said is, "That's a good old piece of subgrade."

Waterproof Your Subgrade

We hear much about stabilization. In its broadest sense all paving operations are a stabilizing of the subgrade to the extent that the subgrade will carry the load. The greatest single factor in this stabilizing process is waterproofing. Any pavement that fails to waterproof the subgrade either when it is new or at any time thereafter has failed in one of its most important functions and is doomed to eventual failure.

▼

Bridge Crossings Fewer

During the fiscal year ending March 31, N. Y. State authorities disclosed today, 357,388 motor vehicles crossed the State-owned Peekskill-Bear Mountain Bridge over the Hudson River or an average of 979 crossings a day. Compared to the previous fiscal year, this was a slight reduction, or 5,154 fewer vehicles, or a slump of less than 1½ per cent. The gross revenue collected at the span for the year was $118,860.

Col. Carey New Secretary Am. Soc. C. E.

Col. William N. Carey has been appointed Secretary of the American Society of Civil Engineers, succeeding George T. Seabury, who died May 25. Col. Carey was released from active duty by the Army on June 1. Previous to this he had been chief engineer of the Federal Works Agency, with offices in Washington, D. C.

Col. Carey was born in St. Paul, Minn., and secured his engineering education at the University of Minnesota. Most of his professional career has been on public works in and around St. Paul. In World War I he served first as captain and then as

Col. William N. Carey

Major in the Corps of Engineers, commanding the 1st Battalion of the 313th Engineers. For several years after the war he was with a firm of consulting engineers in St. Paul. Subsequently he became assistant engineer and the city engineer of St. Paul, Minn., remaining in city employ for 10 years.

When the Public Works Administration began functioning in 1933 he was appointed state engineer for Minnesota. Following this he opened an office in St. Paul, Minn., as a consulting engineer, specializing in roads and sanitary engineering works. He was a major in the Officers' Reserve, and was ordered back to active duty in April, 1941. He became chief engineer of Federal Works Agency in 1942.

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Open Bids on 500 Miles Surface Treatment—The Indiana State Highway Commission opened bids June 5 for bituminous surface treatment on 500 miles of state roads, covering 73 separate projects.

CAA Reorganization Announced by Wright

An organizational rearrangement of the Civil Aeronautics Administration "to meet the urgent problems of postwar expansion in civil aviation activities, both domestic and foreign," has been announced by T. P. Wright, Administrator of Civil Aeronautics. "This reorganization further decentralizes CAA activities, and provides for the determination of policies, procedures and standards in Washington with Administration in the field.

Charles I. Stanton continues as Deputy Administrator; assistant administrators are designated in charge of existing and new Services. Under them, directors of the various services will organize their own activities in accordance with the new plan.

Among changes concerning the airport planning and construction field, Charles B. Donaldson, Director of Airports Service, now becomes Assistant Administrator for Airports, directing three Services: Airport Advisory, Airport Plans and Survey and Airport Engineering and Construction Supervising.

Under the reorganization the nine regional managers become regional administrators, each with eight functional branches including that of airports, and Plant and Structures. They and their headquarters are: Owen P. Harwood, (1st), New York; William M. Robertson, (2nd), Atlanta; H. R. Neely, (3rd), Chicago; L. C. Elliott, (4th), Fort Worth; William H. Kline, (5th), Kansas City; Howard A. Hook, (6th), Santa Monica, Calif.; Paul Morris, (7th), Seattle; Marshall C. Hoppin, (8th), Anchorage, Alaska; and John M. Beardslee, (9th), Honolulu, T. H.

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Bids Asked on Alaska Highway Link

Bids for the first road linking the Alaska military highway with the Pacific Coast highway network have been invited by Herbert Anscomb, British Columbia's public work minister at Victoria. The project, which will cost an estimated $6,000,000 will involve construction of two steel and concrete bridges. Two contracts will be let for construction of a 151-mile highway linking Summit lake north of Prince George, B. C., with Commotion Creek west of Dawson Creek. This connection between British Columbia's highway system and the Alaska Highway will have an overall width of 32 ft. with 24 ft. of the width gravel surfaced.

Editorial

Push the Secondary Job

FARM roads, feeder roads, farm to market roads, call them what you will, secondary roads that will come in for Federal aid after the war need blueprinting no less than trunk projects. One of the points of concern among local officials is the possible high engineering costs for such roads to meet federal regulations.

The real concern should be over the slowness in surveys and preparation of construction plans. Plans for a year's work on this type of project are far from ready in most states.

It should be noted that thousands of miles of lightly traveled county roads have been built in recent years virtually without plans. But the government is going to want plan sheets for its money, and even the simplest design needed will take time. It is regrettable that the secondary road "shelf" has had to be held up so long while county, state and federal people crystallize a set of design standards.

Yet the very thoroughness and sincerity of the effort of PRA and state departments in weighing design recommendations of the counties should be reassuring to all concerned. In nearly every state recently local highway engineer and commissioner groups have met with state leaders and set forth their design ideas in great detail. When the national committee action finally takes place and federal design standards are issued (some time before frost, we hope), these designs will represent real "grass root" study.

The first task is to get a system approved, and to program projects. This will be done county by county, without waiting for stragglers. Meanwhile some states have seen good design progress. Texas, for one, as told in this issue. Minnesota for another. Minnesota in a recent check-up accounted for one-fourth of all this type of projects in the plans stage. A secondary program was authorized in 1943 and the counties sold on the importance of getting busy, using allotments from the $50,000,000 Post War Survey Fund. The state advanced matching money where needed, and 79 of 87 counties have cooperated to date.

▼

Low Cost Road Contractors

THE contractors will play an increasingly important part in low cost road construction. How important is partly up to him. He has been pitched into the farm-to-market picture by the Federal Highway Act of 1944, which requires that secondary as well as primary Federal-aid projects be built by contract. But the counties can and probably will continue to do a considerable amount of force account work. For example, grade and drain to federal standards with local or local-state funds, then set up graveling or paving and bridges as Federal-Aid projects, letting only the F.A. work. Other counties will allocate their federal aid in other ways.

The contractor's ability to get much of this local work will be a matter of economics and sometimes of salesmanship in demonstrating that he has the "know how." There is a wide open postwar field for hundreds of contractors as low-cost road specialists in graveling, bituminous road-mix, soil-cement and other stabilization work. These types of projects are becoming more and more mechanized, and important equipment design innovations due after the war will help step up the whole gigantic job of pulling the nation's farmers and small communities the rest of the way out of the mud.

▼

Planning Lag Jeopardizing Road Program

(By Charles M. Upham, Engineer-Director, American Road Builders' Association, Washington, D. C.)

THE future of American highways and the solution of our unemployment problem squarely rests upon the amount of road projects we have ready to put into operation when the war ends. During the first postwar year, we propose to build more than a billion dollars worth of roads—primary, secondary and municipal. This is the program under the Federal-Aid Highway Act of 1944 which authorized $500,000,000 for the purpose to be matched dollar-for-dollar by the states, and indirectly by counties and cities.

With the need great and with funds available, we might well imagine all our state and local highway departments busy as beavers turning out blueprints, writing specifications and doing all those engineering tasks which must be done before contracts can be let and the actual work started.

Unhappily this is not the case. *Only eight states have sufficient plans ready to make an adequate start; and this lethargy and delay may jeopardize the entire postwar program. It is a matter that concerns every reader of this publication for the condition of the nation's highways affects all of us no matter where we live or what we do.*

The answer is to appeal to those charged with preparing plans to get busy immediately.

Authorities agree that if one billion dollars in construction work is proposed, there should be at least

twice that amount in plans in order to give flexibility to the program. With a choice possible, the first jobs can be started where the demand for employment is the greatest. Say we have plans for a road at Smithville and one at Jonesburg. But Smithville has no unemployment, while Jonesburg men are idle and hungry. Naturally it is the Jonesburg project which should first receive attention. The Smithville job can come later. But if the Smithville job is the only job we have, we face a truly grave situation. So let's plan that Jonesburg job at once.

Findings of an ARBA survey reveal that *only* $685,000,000 *in plans are now completed and these concentrated largely in eight states.*

This is a serious situation. This figure represents only a little more than two-thirds of the actual construction to be done the first year, and *one-third of the plans we should have ready for that year to avoid bottlenecks.* No wonder the people who drive cars and ship by truck are concerned. It is high time that something be done about it by our highway users.

The war is already over in Europe and prospects for victory in the Pacific are bright. Hostilities may terminate swiftly. Are we going to be caught one-third of the way to our goal? That eventuality is not pleasant to think about. It means wasteful, extravagant and unfruitful "made work," unemployment, depression. It should not happen again and highway construction planning is the way to prevent it.

Some highway departments complain that manpower is the cause of their attitude, but let us see what others have done. With true American ingenuity, a number of states have overcome the shortage of highway employees in a variety of ways. Some have employed women at the drafting board and even in the field. This has proved satisfactory, we are told.

Others have called in private engineering firms and this too has worked out well. Some have used engineering students to good advantage, the students receiving credit in their class work and pay for their time. Retired highway employees have been recalled for the emergency, and the payment of overtime for employees, not a common practice in highway departments, did much to step-up plan production. One state is proud of the fact that it has trained high school students to perform the duties of a highway department drafting room. These diverse ways of beating the manpower shortage are not copyrighted. There's no reason why all the states should not use them.

Then, too, former highway employees or young men with engineering experience which can be adapted at once to highway department requirements are returning daily from the war zones. An appreciable number of such potential rodmen, draftsmen and technicians are now available. They should be used.

In order to present a complete case against delay, the *reminder should again be made that federal funds have been set aside in the Act of* 1944 *for financing highway plans.* This removes the last barrier that might be holding up essential planning.

The states that have been the most negligent have announced that their requirements far exceed the mileage that can be built from funds allocated for the first three postwar years. A big job lies ahead. The spotlight is on the lagging highway departments and the officials who have it within their power to get more action on plans.

WPB Relaxes Controls on Clearing, Grading, Drainage

THE first step in relaxing wartime controls on highway construction was taken on June 4 by an amendment to Conservation Order L-41-t which permits the carrying on of earth-moving operations without restriction. Highway and street construction may now be started without WPB authorization if the work consists of:

"Grading, ditch-digging or similar earth moving operations ff no lumber or other building materials are permanently installed, except drainage pipe and culverts including headwalls thereof"

Clearing, grubbing, grading and drainage may now be undertaken without the necessity for obtaining WPB project authorization and may be performed in preparation for additional future construction operations. There is no dollar limitation to the grading work that may be done under this exemption. It is understood that the term "culverts" includes any minor drainage structure having clear span or lengths of 20 ft. or less between abutments.

Federal Aid Still Restricted

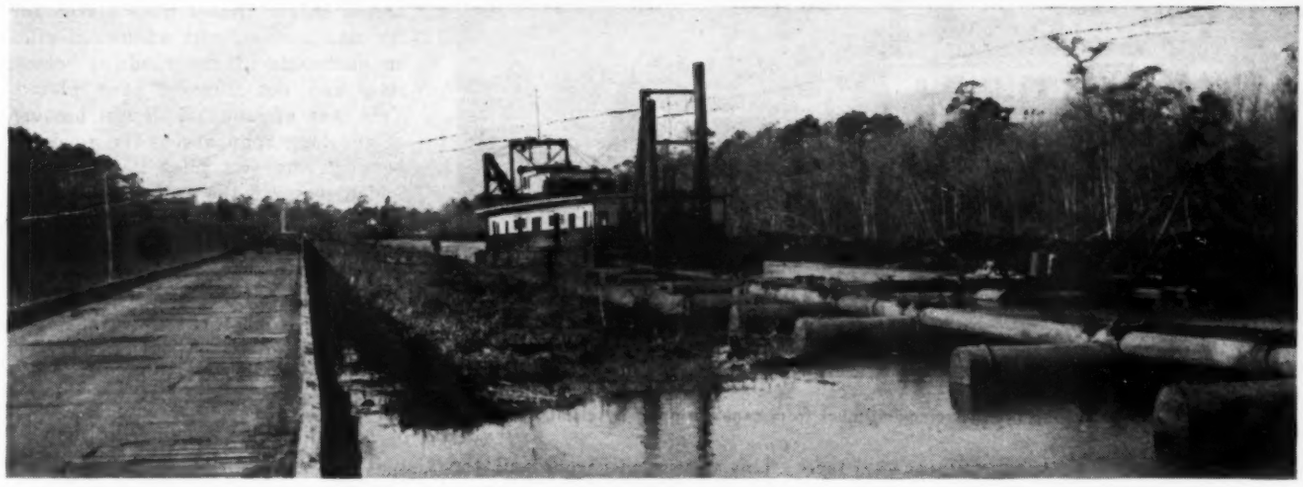
However, this exemption will have no immediate appreciable effect insofar as projects involving federal highway funds are concerned. Such funds are either restricted to projects essential to the war effort or by law will not become available until the termination of the war emergency.

In accordance with this action the ARBA has petitioned Congress to authorize the immediate appropriation of the funds for the so-called "first postwar fiscal year." Provision for such action is contained in the Act of 1944 wherein it is provided that Congress by concurrent resolution of the two houses may make the funds immediately available if the war effort has been relieved to an extent justifying the commencement of highway construction. The recent WPB relaxation of L-41-e indicates the justification for making federal highway funds immediately available.

Meanwhile, relaxation of control of construction activities in general was made by an amendment to Order L-41.

Major changes of the amended order are the raising of the annual dollar value limits on various types of construction that may be undertaken

(*Continued on page* 109)



General view of dredging operations in progress alongside old causeway. Note pontoon supports for dredge pipe used in muck disposal

Rebuilding North Carolina's "Floating Road"

How modern hydraulic filling methods are being used to solve a 25-year-old swamp road problem

By W. VANCE BAISE
State Highway Engineer of N. Carolina, Raleigh

SINCE the days, more than 40 years ago, when the merchants of Elizabeth City decided they must have a quicker and cheaper approach to their city from the east, engineers have had many perplexing headaches concerning ways and means of solving this problem. The merchants organized what was then known as the Camden Ferry Company and attempted to construct a road across what is known as "Floating Goat's Island".

A ferry was used for moving traffic across the Pasquotank River, between Goat's Island and the city, until about 1910, when it was replaced by a narrow steel drawbridge with timber approaches. This bridge remained in use until 1931, when a modern bascule steel draw span, with reinforced concrete approaches was built over the Pasquotank River. This bridge was completed in 1931 at a cost of $392,984.

Dates Back to 1921

In 1921 the State Highway Commission realized that the public service which was being rendered by the private toll road was entirely inadequate to meet the needs of the people in that area, and decided to purchase the road and make it a part of the State Highway System. The road in question is now designated as US 158 and forms a most important connecting link to the Counties of Camden, Currituck and Dare, which lie east, and also forms an important connection to certain sections of Virginia, including the Norfolk and Portsmouth area. When purchased by the State it was the only connection to the east, as well as to the Norfolk area. The roadway consisted of a shallow earth covering over the light timber causeway, lightly surfaced with oyster shells, and the river was spanned with a narrow steel drawbridge with tim-

Clamshell machine removing piling from old causeway and stripping root mat

Another view of suction dredge removing muck from canal stripped by clamshell

ber approaches. The road could accommodate only light traffic and was impassable most of the time.

When it was first decided to improve the road it was not considered possible to fill in the swamp, due to its location in a low, flat area, depth of muck, and extreme difficulty and expense in getting sufficient borrow material. An experimental design was prepared for a floating road, which consisted of a very heavy log corduroy placed on top of the old road and covered with a thin earth cushion supporting a reinforced concrete pavement. Construction of this roadway started in July, 1922, and was completed a year later. During construction the original design called for a 16-ft. pavement and 6-in. curbs on each side. This was found impractical and the design was changed to 17 ft. width without curbs.

Floating Construction Tried

At that time the timber corduroy was thought to have sufficient supporting value to float the comparatively light section of roadway on top of the swamp. This did not work out very satisfactorily, however, for by the time the pavement was completed so much settlement had occurred that in several places normal water level was an inch or more above the surface. This continued throughout the entire length of the roadway, which covered a distance of 2¼ miles, and by 1924 it became extremely difficult for traffic to get through when wind tides raised the water level above normal. It may be noted that about ¼ mile of this road, on the east end of the swamp where the root mat was heaviest, and where muck did not exceed 15 in., is still in service, even though it is partially covered with water a large portion of the time.

During 1924 and 1925 it became necessary to raise the lower sections of this road, and slag was placed on top of the concrete pavement. This was held in place by boards nailed to timber piles which were driven at 10-ft. centers on each edge of the pavement. This design contemplated the use of these piles as supports for a possible future concrete slab in case the settlement continued. After building up sections in this manner, totaling about one-half mile in length, it was seen that this would be only a temporary relief and that a more permanent type of road was necessary.

In 1926, the next act was to cover up the old road with a creosoted timber causeway. Construction was started on this causeway which provided a 17-ft. clear roadway, and supported on the timber piles driven for the slag section, with additional piles on each side of the roadway where slag had not already been placed. This was an unusual design because of the long span across the roadway between the two piles in each bent which required the use of 14 x 16-in. timber caps. Trestle construction was carried on intermittently by the Bridge Maintenance Department from 1926 through 1931, and by that time the entire timber causeway had been covered so it was continuous from the Pasquotank River Bridge for a distance of 2 miles east.

Fill being discharged from end of pipe line. "Bleeders" are building up top suction

Maintenance Became Problem

The creosoted timber causeway was designed for a live load of one 15-ton truck and gave excellent service for a number of years. However, this road has been subjected to increasingly heavy and high speed traffic. This condition has especially been true since the beginning of the war, due to the Naval Bases and Shipyards in the vicinity of Elizabeth City. As result of this increased traffic the causeway has become extremely costly to maintain, due to vibration under heavy loads, causing breakage of the wearing surface, floor and stringers. This is not entirely due to the heavy loads, but also to the age of the timbers involved. Due to the narrow width roadway, sharp curves, and extreme difficulty in keeping the road in satisfactory condition, it has become very dangerous to fast moving vehicles.

Consideration was given to an entirely new location of this road so as to avoid the deep muck crossing, but this was not found advisable due to increased travel distance and the further fact that the drawbridge over the Pasquotank River could not be abandoned. An extensive survey of this area was made several years ago, and a new location worked out that would eliminate sharp curves and take advantage of the shallowest sections of the swamp. This location crossed the existing roadway in one place, but otherwise was located at a sufficient distance from the present road to permit traffic to use the existing causeway during construction. Sufficient material was located in the river, or within a reasonable pumping distance, to make it practical and economical to place a solid hydraulic fill throughout this swamp.

Sand Filling Approved

In 1942 agreement was reached to rebuild on this new location by removing all muck and vegetation, including many large trees that had grown over the swamp, and placing a sand fill for an adequate width as a

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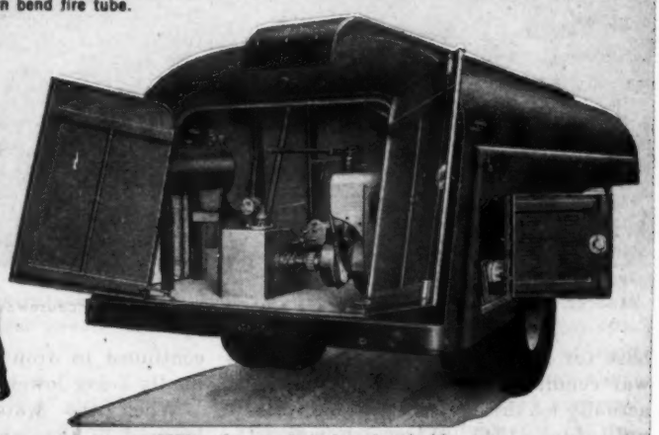

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Fill material in place adjacent to old "floating road" near east end of project

Fill material in place adjacent to old timber causeway.

base for a future pavement. Due to war conditions it was not possible to actually let the contract for this work until June, 1944. First job was to clear the right of way, and a dragline machine (with clamshell bucket) was set to work stripping the muck and vegetable matter for the proper width of the roadway. This was followed up by a dredge which cleared out all soft material down to a solid clay, or sand foundation. The depth to this solid material ranged from 15 to 45 ft. Soon after the first dredge began pumping out the soft material, a second dredge was started, pumping earth material into the canal to fill it up, and this plan of operation has been followed throughout the construction period.

This project involves clearing necessary right of way, the removal of 591,300 cu. yd. of muck, and other unsatisfactory material and the pumping in of about 1,000,000 cu. yd. of solid fill. The worst of the complications struck the project on September 14, 1944, when a tropical hurricane of unusual violence hit this area, with velocity greater than 100 mph. The wind blew much water out of the river and the water elevation continued to drop for several hours, finally being lowered about 7 ft.

When the water elevation was lowered in the canal, it reduced the pressure on the muck along the sides of the canal, causing it to slough and resulted in a considerable amount of extra dredge operations on the part of the contractor to remove this sloughed material.

After the wind had subsided and the water returned to the river, work was resumed and it has progressed since without any serious hindrance.

The new fill, which is expected to be completed sometime in September of this year, will provide a 40-ft. roadway. At the present time, (May, 1945) the contractor has practically completed removal of the root mat and 80% of the muck. Sand fill replacement is 60% completed. The contractor is using a dredge with a capacity of 10,000 cu. yd. per 24-hour day. His actual average progress has been much less, since much of the sand pumped is very fine, causing it to flow off in solution.

After this work has been completed, it is the plan to immediately let the contract for a 22-ft. flexible-type pavement which will be either sand asphalt or gravel base with asphalt top. Also 9-ft. shoulders will be constructed on each side of the pavement.

It is believed when this project has been completed, we will have one which, with proper maintenance of the pavement itself and the turfing of the shoulders, will permanently remain in place and we will, therefore, have solved a problem that has been vexing to the engineers in this state for a long time.

Project Evoked Wide Interest

Engineers from many sections of the country have watched the progress of this work with closest interest, not because there are very many roads in this nation where engineers will likely encounter similar problems but because this work has been rather unique and of an unusual nature in highway construction.

The engineers of this state have been particularly interested in the project, due to the fact it is believed to be the final disposition of one of the costliest projects in the 25-year period of highway construction in this state. The contract is being handled by the R. C. Huffman Construction Corporation of Norfolk, Va., Vice President C. W. Berger being resident manager. Engineering work is under Resident Engineer W. J. Overman of the State Highway and Public Works Commission, J. C. Gardner, division engineer.

The contractor is making good progress at the present time and we have had very fine cooperation from him in connection with this work. We are hopeful that the present contract will be completed in time to place pavement in 1945.

▼

Minnesota Maintenance Budget $3,198,500

The 1945 road maintenance and repair budget for the Minnesota state department of highways, as approved May 1, includes the following items, spread over the 11,260-mile truck system.

Class I Operations—Repairs and Replacements	
Culverts	$ 924.00
Ditch Cleaning	76,965.35
Miscellaneous	106,241.33
Class II Operations	
Calcium Chloride Application	64,980.89
Gravel Surfacing	372,699.33
Bit. Surface Repairs	1,525,219.24
Bit. Seal Coat	359,682.52
Extraordinary Maintenance	
Expenditures in two districts	21,321.06
Class IV—Betterments	
Bituminous Surfacing	532,563.32
Sub-grade Correct.	2,670.87
Sand-Grav. Lifts (Base)	28,382.20
Grading (Reshaping)	27,968.08
Grade Lifts	7,482.31
Culverts, Drainage	6,972.02
Roadside Development	
Seeding	9,535.00
Planting, Trimming	54,893.30
TOTAL	$3,198,500.82

Secondary F. A. Road Progress

*

The Federal Highway Act of 1944 specifically set up $150,000,000 annually as Federal aid to secondary highways for the first three postwar years. A committee is at work on standards. The highway departments are currently meeting with local officials and are making good progress in laying out respective state secondary systems. Herein are some of the latest developments

*

A calcium chloride gravel road in Olmsted County, Minn.

How Routes Are to Be Selected

Instructions issued to field offices of Public Roads Administration, May 24, 1945. Progress has been made in many states anticipating these requirements.

THE following procedures are issued for the purpose of carrying into effect those provisions of the Federal-Aid Highway Act of 1944, and of the Regulations which pertain to the selection of a system of principal secondary and feeder roads. This system, in general, will be identified by the title, "Federal-aid secondary system," to conform to past practice and to distinguish such secondary systems in each State from the trunk line Federal-aid highway system.

These instructions amplify and supersede previous instructions and also embody certain suggestions made by the Subcommittee on Legislation and Administrative Policy of the Executive Committee of the American Association of State Highway Officials for the purpose of clarifying and simplifying several steps in the procedure.

Section 1.2 of the Regulations, which expresses the intent of the Act, and section 1.4 covering the selection and designation of the several systems, establish the broad policies and principles which should govern the selection of the Federal-aid secondary system. The Act is held to establish the pattern for a long-range program of highway development designed for the national defense and to serve the major classes of highway traffic broadly defined as (a) interstate or interregional, (b) intercity or intrastate, (c) rural secondary or farm-to-market, and (d) intra-urban.

The objective of the specific provisions of the Act with respect to secondary roads is considered to be a more comprehensive rural road program through the selection and improvement of a system of principal secondary or feeder roads supplementing the Federal-aid highway system in rural areas, so that together they will form an integrated network in which the two systems complement each other as trunk line and feeder routes.

Some Primaries May Become Secondaries

If the proper allocation of rural trunk lines and feeders is to result it will be desirable to review, and modify as necessary, the Federal-aid highway system before undertaking what might be considered a final or complete selection of secondary routes. Routes included in the Federal-aid highway system which perform a secondary or feeder service can now be adequately provided for in the Federal-aid secondary system and should be transferred to that system. An advantageous result of such transfers is that mileage thus eliminated from the Federal-aid highway system becomes available for the inclusion of intercity rural routes and arterial distributing routes in urban areas without exceeding the legal limitation on the total extent of the system.

An important reason for proceeding cautiously in the selection of a complete secondary system is the provision of section 1.4 of the Regulations that the extent of the overall mileage of the several systems shall be a mileage which can be brought to a state of adequate improvement within a reasonable period of years, and which can be maintained and reconstructed as required, with the estimated income that will be available from all sources for these purposes. Such a determination is by no means a simple problem. It will require skillful use of facts and techniques developed by the highway planning surveys, and probably will be the result of several successive approximations. It will also require review and revision from time to time thereafter.

It is suggested, therefore, that the federal-aid secondary system in each state be selected and submitted for

DOLLARS DOWN TO EARTH

BUDGET-SAVERS—these Blue Brutes! When postwar construction plans come down to earth, they'll keep down costs on jobs like this:

> *Pittsburgh's $36,000,000 public works program including $4,719,550 for water mains, $9,142,500 for streets, $3,494,000 for sewers.*

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HS-3

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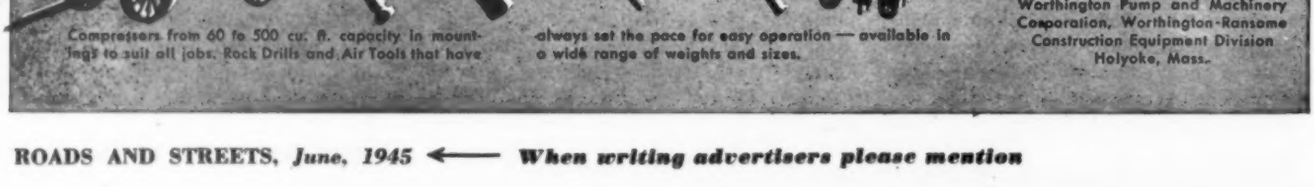


approval in progressive stages. The detailed requirements for the selection of secondary routes and the procedure for submission and approval are as follows:

Roads Eligible for Inclusion

The term "secondary and feeder roads" means roads in rural areas, including farm-to-market roads, rural mail routes, and school-bus routes, but not limited to roads of these specific descriptions. The term "rural areas" means all areas not included within the urban areas delimited about municipalities of 5,000 or more population. The term "secondary and feeder roads," therefore, includes appropriate streets within those municipalities of less than 5,000 population which are not included within urban areas. The definition does not exclude roads which are parts of the state highway system. Any road located in "rural areas" as defined, which is not included in the Federal-aid highway system, may be considered as complying with the definition.

However, the funds authorized by the act for secondary and feeder roads are available for expenditure only on principal secondary and feeder roads and on a system of such roads selected by the state highway departments in cooperation with county supervisors, county commissioners, or other appropriate local road officials, and the Commissioner of Public Roads. The term "other appropriate local road officials" is construed to include the appropriate officials of the municipalities in which Federal funds may be expended on routes of the system to be selected. The requirements for cooperation with local road officials in the selection of the system is considered a basic requirement of the Act applicable in every state to the initial selection of the system and to all extensions and modifications thereafter, and is not modified or waived by any other provision of the Act.

In a county or other political subdivision of a state in which all public roads and highways are under the control and supervision of the state highway department, that department may be considered the local road authority and cooperation with other local authorities of such political subdivision is not required. The manner or method of cooperation with the local road officials shall be determined and exercised by each state highway department.

The cooperation of the Commissioner of Public Roads will take the customary form of review and approval of the system submitted by the state highway department for formal action. Field personnel of the Public Roads Administration will be available to assist the state highway department in studies leading to the selection of the system.

Requirements for an Integrated System

In order to meet the general requirements for integration with the Federal-aid highway system, routes selected for inclusion in the Federal-aid secondary system should connect at least at one end with a Federal-aid highway route either directly or through other Federal-aid secondary routes.

In many cases it will be necessary to effect such connection and integration of the Federal-aid secondary system with the Federal-aid highway system by means of designated portions of routes which fall inside the boundaries of urban areas, even though such portions may be ineligible for improvement with Federal-aid secondary road funds.

Urban Exception in Certain States

In Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, the District of Columbia and Puerto Rico (population density exceeding 200 per square mile) the state highway department, in cooperation with the appropriate local road officials, and with PRA approval, may select the system without regard to municipal boundaries.

Other Exception

In Delaware, West Virginia, North Carolina, District of Columbia and Puerto Rico—these being the only "states" in which all public roads and highways are under the control of the state highway department—a system of principal secondary or feeder roads must be selected in accordance with the general requirements of the act; but the funds apportioned to these states for projects on secondary or feeder roads may be expended for projects on the Federal-aid highway system, if, and to the extent that, the state highway department and the Commissioner of Public Roads jointly agree that such funds are not needed for use on the system of principal secondary and feeder roads selected.

Transfers between Systems

In accordance with the provisions of Regulation 1.4, when conditions warrant, transfers of routes may be made between the F.A. highway system and the F. A. secondary system. In the previous designations of F. A. secondary road systems it has been the practice to omit certain routes as potential future additions to the Fed-

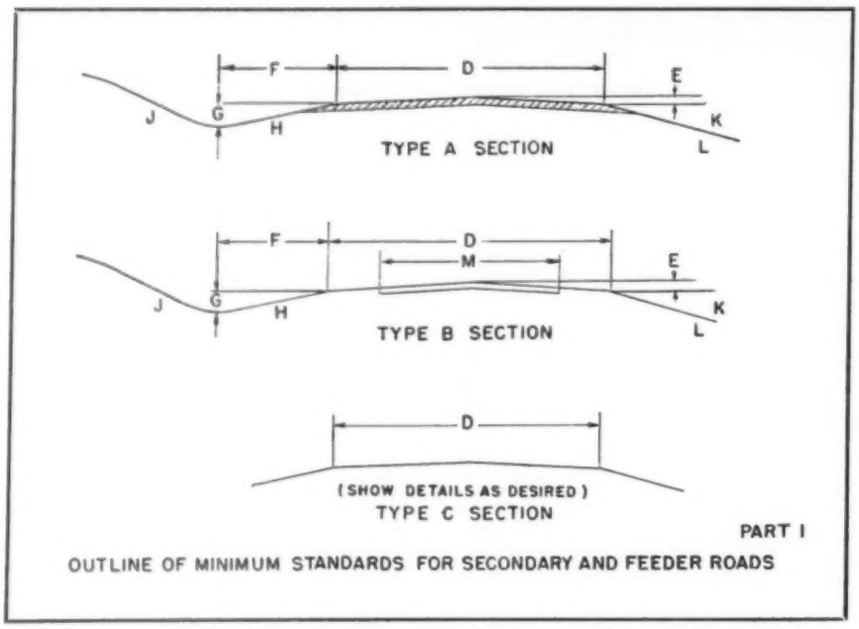


Fig. 1. Typical cross section diagrams used as basis for Minnesota design consensus

eral-aid highway system. In view of the provisions of Regulation 1.4 there generally will be no occasion to reserve mileage for future additions to the Federal-aid highway system. Furthermore, the probable relative financial provision for the two Federal-aid highway systems in the future and the expected need of more costly improvements of the trunk-line Federal-aid highway system suggest the advisability of holding the latter system within relatively low percentage limits.

Selection and Submission of Secondary System

Criteria and methods previously followed in the selection of a Federal-aid secondary system are suggested as guides to the present selection of the Federal-aid secondary system. Using such criteria and methods, the State highway departments, in cooperation with county supervisors, county commissioners, municipal authorities, or other local road officials concerned in each county, should select and submit an initial stage of the system as promptly as possible for consideration and approval by the Commissioner of Public Roads. It is not necessary that the first submission include mileage in every county in the State. The first submission may comprise any substantial number of counties in which the concurrence of local officials has been obtained. The initial stage should thereafter be completed without undue delay by one or more submissions for the remaining counties of the State. **In order to provide for the obligation of Federal-aid secondary road funds authorized for the three postwar years, it is desirable that the initial stage of the system be selected and approved as promptly as possible and that the mileage thereof be sufficient to provide considerable latitude in the selection of projects.**

It is contemplated that, in those States where a substantial mileage of the Federal-aid secondary system has previously been approved, a review of the system with local road officials should generally result in its adoption, possibly with some modifications, as the initial stage of the new Federal-aid secondary system.

During the time construction is in progress on routes included in the first stage of the system, it is expected that the State highway departments will complete a comprehensive analysis to determine the ultimate extent of the several integrated systems that can be maintained, constructed, and reconstructed within the limits of the funds that can be anticipated will be available in the foreseeable future. As a result of this analysis it should be possible to include in the second stage the final selection of routes that will complete each of the systems. Modifications of any system or transfers between systems can of course be made at later dates as changing conditions in the future warrant.

Maps and Supporting Papers Required

The following maps and supporting papers are desired by the Washington Office in submission of routes:

1. A map of the State to convenient scale and a set of planning survey county maps showing traffic flow data, on which should be indicated the Federal-aid highway system and the proposed Federal-aid secondary routes with assigned route numbers. Maps will be retained in Washington.

2. A tabulation of the selected system, in triplicate, prepared on standard letter size paper, giving the information shown in the attached sample. Two copies will be retained in the Washington Office; one approved copy returned to the State through the Division Office.

3. An explanation of the methods

Standard Form for Submitting Federal-Aid Secondary System Routes for PRA Approval
(Hypothetical data used as example)

Route Destination FAS Rt. No.	State or Local Route No.	Brief description of route and termini	County	Mileage on State Highway System	Mileage on Local System	Total length
*1	County road	From FAS Rt. 405 at Daleville northeasterly to FA Rt. 1 in Newton	Dale	..	6.9	6.9
2	S. H. 28	From FA Rt. 4 north of Waldron northeasterly to FA Rt. 7 at Ozark; from FA Rt. 7 north of Ozark northerly to FA Rt. 3 at Eureka Springs	Scott	15.0	..	..
			Logan	16.0	..	..
			Franklin	22.3	..	..
			Madison	38.0	..	..
			Carroll	29.0	..	120.3
*3	State suppl. Rt. 5 and County road	From FA Rt 25 east of Arcadia southerly to FAS Rt. 13, thence southerly to FA Rt. 107 in Whitesville	Nodaway	8.0	..	..
			Andrews	1.2	10.2	19.4
4	S H. 9	From FAS Rt. 960 south of Dresden easterly to FA Rt. 36 south of Norton; from FA Rt. 36 north of Hill City easterly to FA Rt. 32 northwest of Porter	Sheridan	14.0	..	..
			Decatur	16.0	..	..
			Norton	17.0	..	..
			Phillips	22.0	..	..
			Smith	23.1	..	92.1

Notes: Use asterisk with FAS Route number to designate routes approved in whole or in part prior to Act of 1944. Mileages are total lengths of route including any ineligible portions.

and criteria employed in the selection of routes.

4. An explanation of the manner in which the cooperation of local road officials has been sought and obtained, and a statement as to their concurrence in the roads selected.

These maps and supporting papers should be submitted by the State highway department through the Division Engineer, who will forward them with his comments and recommendations for consideration by the Commissioner of Public Roads.

How Minnesota Arrived At Design Recommendations

Outline of instructions sent out by Minnesota Chief Engineer, O. L. Kipp, to a special, state-county highway engineer committee, showing basis for effort to arrive at preliminary design recommendations for Federal-aid secondary roads in Minnesota and the Dakotas in cooperation with county engineer associations. Mr. Kipp is one of the several members of the AASHO's Special Committee on Planning and Design Policies, scheduled to meet late in June, 1945, to consider nationally the scope of surveys, plans and design standards for secondary and feeder roads as defined in the Federal-Aid Highway Act of 1944

FOR the purpose of expediting consideration by a committee of the Minnesota County Highway Engineers Association, the state department of highways prepared report forms on which suggested standards can be submitted for F.A. secondary highways. It is suggested that "minimum standards" be construed as the data to be used for minimum design under average conditions but not necessarily for exceptional cases which need to be decided separately. Such minimum standards will be "floor" values, to be exceeded whenever practicable.

Fig. 1 shows in diagrammatic form two general types of cross sections, "A" and "B", as basis for this study, believed sufficiently general for indicating suggested dimensions for practically all types of secondary or feeder road cross sections.

Fig. 2 shows a preliminary consensus of Minnesota, N. Dakota and S. Dakota opinion on one bracket of design traffic volume: 5 to 20 vehicles per hour. Similar data were charted for four other brackets: 0-5, 20-40, 40-100, and 100-300 vehicles per hour.

As a basis for preparing these recommendations a tabular form for reporting suggested minimum standard control items was also sent out. This form (not shown) included space for suggested dimensions for cross sections. Where type "A" or type "B" did not apply, type "C" section could be completed. The following headings were included:

Basis for Design

Design traffic volume: In the absence of specific relations these values could be considered as 10 per cent of the annual average 24-hr. volumes. Five groupings listed, other volume groupings could be suggested. The first group (0-5 per hour) covered feeder roads largely of a land service classification and on which extensive field and office work cannot be justified.

Type of terrain: Three general classes of topography shown.

Design speed and type of traffic: Values to be reported on basis of increments of 10 mph., traffic type "P" (predominately passenger cars) and "M" (mixed).

Sharpest curve: Suggested maximum curvature in degrees.

Maximum Grade: Suggested steep-

OUTLINE OF MINIMUM STANDARDS FOR SECONDARY AND FEEDER ROADS

STATE Minnesota

Report by	Design traffic volume (vehicles per hour)	Type of terrain	Design speed and type of traffic (mph-P, M, or T)	Sharpest curve (degrees)	Maximum grade (percent)	Minimum sight distance: Non-passing (feet)	Minimum sight distance: Passing (feet)	New bridges: width and design loading (feet-tons)	Existing bridges to remain: width and safe load (feet-tons)	Width of right-of-way (feet)	Details of cross section: Type of Section (A, B or C)	Details of cross section: Code type of improvement	Details of cross section: Roadbed width D (feet)	Details of cross section: Roadbed Crown E (inches)	Details of cross section: Width from edge of roadbed to bottom of gutter F (feet)	Details of cross section: Depth of gutter G (feet)	Details of cross section: Rate of slope: Roadbed to gutter H (x:1)	Details of cross section: Rate of slope: Cut face J (x:1)	Rate of slope, low fills K (x:1)	Minimum height of high fills (feet)	Rate of slope, high fills (x:1)	Width of surfacing or pavement if any L (feet)	Rate of slope M (x:1)	Estimated cost per mile (dollars)	Remarks
Dist. 1			50	10	7	350	1400	24		100	A	IV	24	4	9	3	3:1	2:1	3:1	10	2:1	24		9000	
" 2																									
" 3																									
" 4	8		50 P	8	5	350	1000	24 20	18 15	100	A	IV	24	5	14.00	3	3:1	3:1	3:1	5	1½:1	22		5000	
" 5		T	M 50	10	4	350	1400	24 20	18 15	66+55	B	IV	26	4	12	3	3:1	3:1	3:1	←	2:1	24		4000	
" 6		A	M 40	10	5	400	—	24	18 8	100	A	IV	22	3½		3.5	3:1	3:1	2:1	—	2:1	20		—	
" 7																									
" 8		J	M 50	8	4	350	—	24 20	24 15	90	A	IV	26	4	12	3	3:1	4:1	3:1	8	2:1	26		4000	
Central Office																									
South Dakota		B	40	16	6	200	—	16 H15	16 6	66	A	I, IV	24	3	6	2	3:1	2:1	3:1	7	2:1	20		4000	(Grav. Surf.)
North Dakota	20		50	5	6	350	1400	24 H15	20 H15	180	B	IV	26	4	10	3	4:1	4:1	4:1	6	2:1	0			
Committee			50	9	5	—	—	24 H15	18 8	82.5	A	IV	24	4	12	3	3:1	3:1	3:1	5	3:1	20		5000	
Dist. 1			50	10	7	350	1400	24		100	A	IV	24	4	9	3	3:1	2:1	3:1	10	2:1	24		12000	
" 2																									
" 3																									
" 4	8		40 P	12	6	275	700	24 20	18 15	100	A	IV	24	5	14.37	3	3:1	2:1	3:1	6	1½:1	22		5000	
" 5			M 40	10	7	275	900	24 20	18 15	66+55	B	IV	26	4	12	3	3:1	3:1	3:1	←	2:1	24		10000	
" 6			M 40	10	9	400	1600	24 H15	18 - 8	80	A	IV	20	3½	—	3	2:1	2:1	1½:1	—	1½:1	18		—	
" 7	70																								
" 8			M 40	8	6	275	—	24 20	24 15	90	A	IV	26	4	12	3	3:1	4:1	3:1	8	2:1	26		4500	
Central Office																									
South Dakota			40	16	6	200	—	16 H15	16 6	66	A	I, IV	24	3	6	2	3:1	2:1	3:1	7	2:1	20		4500	(Grav. Surf.)
North Dakota			40	8	8	275	900	24 H15	20 H15	150	B	IV	26	4	10	3	4:1	2:1	4:1	6	2:1	0			
Committee			50	9	8	—	—	24 H15	18 8	82.5	A	IV	24	4	12	5	3:1	3:1	3:1	5	3:1	20		7000	
Dist. 1																									
" 2	5																								
" 3																									
" 4	8		30 P	20	8	200	500	24 20	18 15	100	C	IV	24	5	5.00	7.5	2:1	—	2:1	5	1½:1	22		10000	
" 5																									
" 6			M 30	10	10	275	—	20 —	18 8	80	A	IV	20	3½	—	2	2:1	1½:1	1½:1		1½:1	8		—	
" 7																									
" 8																									
Central Office																									
South Dakota			25	24	10	100	—	16 H15	16 6	66	A	I, IV	20	2½	3	1	3:1	1:1	3:1	7	2:1	18		6000	(Grav. Surf.)
North Dakota			40	8	8	275	900	24 H15	20 H15	150	B	IV	26	4	10	3	4:1	2:1	4:1	6	2:1	0			
Committee			40	14	12	—	—	24 H15	18 8	82.5	A	IV	24	4	7	2	2:1	4:1	3:1	5	1½:1	20		13000	

● Dist. 4 & 5 to 10 Vehicles per hour

⊕ 50' to 80' Span
● 80' Span or over

Fig. 2. Outline of minimum recommended Minnesota (and Dakota) standards for secondary and feeder roads, as compiled in cooperation with local authorities. Minnesota county highway engineers in discussing these details showed special concern over the construction cost of designing vertical curves to AASHO sight distance standards. Minnesota design conferences brought out the interesting fact that the average secondary highway in Minnesota will carry more traffic than the average primary road in North Dakota

est controlling gradients in per cent. Corresponding maximum lengths to be shown if desired.

Minimum sight distance: Minimum values to be reported on the basis of AASHO's "Policy on Sight Distance for Highways," i.e., for nonpassing, a height of eye of 4.5 ft. and height of object of 4 in.; for passing, a height of both eye and object of 4.5 ft.

The exhaustive detail with which this committee job was conducted is shown by the further report headings, which include recommended width and design load for new bridges, same for existing bridges, r/w width (minimum), type of section (see part 1), type of improvement, roadbed width, crown, width to gutter, gutter depth, slopes, fill height and surfaced width.

Estimated cost per mile including minor structures is to be indicated. Code types to include the following: I—Graded and drained earth, plain. II—Graded and drained earth, stabilized. III—Soil surface. IV—Traffic bound metal surface. V—Water-bound macadam. VI—Bituminous surface treated or soil cement. VII—Low cost bituminous mixtures. VIII—Bituminous macadam. IX—Bituminous concrete, P. C. concrete, brick or block.

Texas Mapping $60,000,000 in Secondary Roads

WHEN war restrictions are fully lifted the Texas Highway Department expects to be ready to go with a $20,000,000-a-year farm-to-market road program that is "what the Texas rancher ordered." Texas has over 170,000 miles of rural highways. "Principal farm roads" alone total 26,000 miles. With 70% of the state's rural population still in real need of lateral road improvements to assure them all-weather outlets, the Department has wisely decided to go the limit on a Federal-aid secondary highway program. Its allotment, incidentally, is the largest of any state —$10,043,000 annually.

The political and engineering soundness of this move can be seen by the following facts:

Texas population is 47.5% rural (1940 census).

While the 27,000-mile state system has been extensively surfaced and given a $716,000,000 investment in 27 years, the 143,000-mile local road grid is still largely dirt, mud and dust.

Seven out of every eight rural citizens depend on *county* roads for immediate outlet.

Of these dependent people, 55%

"...now use Ring-Free exclusively..."

Excerpts from letter of—
N. G. HILL
N. G. Hill & Co., Contractors
Phoenix, Arizona

"...four years ago, after we purchased a fleet of Chevrolet trucks for a road construction job on Highway 77, we were induced to try Ring-Free Motor Oil.

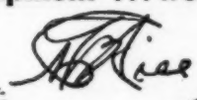
...the test was a tough one due to weather conditions...heavy snow and rain in winter...heat and dust storms in summer.

...during all this time we did not pull a head or pan in any of the trucks except one damaged by striking a huge boulder.

...after the job was completed we removed heads and pans on all motors which had from 50,000 to 60,000 motor miles.

...all compression rings were free...all drain holes in oil rings open...also drain back holes in pistons completely open and no carbon on the under side of the pistons. Cylinder heads and valves were also clean and all valve stems free in the guides. Engine pans and oil pump screens were cleaner than we expected...all bearings were in good shape.

...we now use Ring-Free exclusively in all our equipment*...we recommend Ring-Free Motor Oil to other contractors."



** 36 Trucks—Fords, Chevrolets, Internationals; 6 A.C. Tractors, Diesel powered. 1 D-8 Caterpillar; 3 Graders—2 powered by International and 1 by Caterpillar motor; 1 International T. D-40 Tractor; 1 Lorraine 40—¾ cubic yard power shovel; 3 Light Plants powered by Kohler motors; 1 Gravel plant powered by 8800 Caterpillar Diesel. Also numerous pick-ups and station wagons.*

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have only earth roads for immediate service; 24% have soil-surfaced, gravel or stone roads; only 21% have adequate all-weather facilities.

Program Shaping Up

Tangible steps taken to date include these:

1. A construction and maintenance program for 7,205 miles of farm-to-market routes has been announced. Of these, 5,830 miles are farm roads that the state will surface and maintain, the counties having formerly paid the upkeep; counties are thus to be relieved to develop their local roads more rapidly. And 1,375 miles represent roads previously state-built and now state maintained.

2. Without waiting on the adoption of Federal design standards, the Department has informally gone ahead on construction plans. "We have a fair idea of what the design requirements for PRA approval will finally be," explained Chief Engineer D. C. Greer. "We are well along on working plans for primary roads, having over $100,000,000 completed or in the planning stage, but our secondary design job has been stymied. We felt we had to make some kind of a start, in case the war ends sooner than expected. As of May 1 over 1,000 miles of secondary projects were programmed, and many were 'moved out' already."

Special Department Formed

3. A Division of Land Service Roads, in charge of B. B. Freeborough, has been established in the Department, separate and apart from the Division of Road Design and having equal rank with it. This was done not merely in recognition of the bigness of the secondary road task, but because secondary highways are believed to require a fundamentally different approach or philosophy in design and administration.

"It is most difficult for an engineer to think in terms of sound primary road standards in the A.M. and farm-to-market concepts in the P.M.," Mr. Greer is again quoted. One is primarily a through *highway*, the other a land service facility, and each needs the single-minded attention of a department of specialists.

The state department some months ago picked the purposely limited mileage (7,205 miles) as the largest it could undertake to improve and maintain with fund sources in sight. The procedure in picking the routes was to decide on the overall mileage that could probably be financed to desired standards, break the mileage down by districts by using a rough formula, and let each district work out mileages and routes for individual counties in cooperation with county commissioners courts.

Only three rules were laid down to guide selection:

The route must join an existing highway at at least one end, must be on a bus or school route, and must not pass through sub-marginal land. The limited mileage selected serves the denser agricultural areas. Traffic volume and other service data from the Planning Survey maps guided priority selection. Research has determined the necessary minimum traffic which will justify draining and surfacing a road at a given cost level, based on maintenance and 15-year construction retirement period.

In general all projects are on the under-100-vehicles-per-day roads of which the state has 26,000 miles.

Throughout all negotiations the Department's principle has been to sincerely determine and serve the local need, and see that local people are "sold" and in accord. "We think of ourselves here in the Highway Department somewhat in the light of a merchant," pointed out Mr. Greer. We must lay in a stock of goods that the people want and need. In Texas, this stock is a soundly conceived "shelf" of secondary roads, all tied up in packages ready for delivery as soon as possible after the war."

Guadalupe County, Texas, Tabulation Showing Data on Suggested County Road Improvement Plan

Traffic Priority	Length Miles	Average 24-Hour Traffic	Present Condition — Unimproved	Present Condition — Metal Surface	Present Condition — Bit. Surf.	Recommended Improvement — Bituminous Surf.
1	5.9	290	4.1	1.8	....	5.9
2	6.8	201	1.0	5.8	....	6.8
3	9.8	185	0.5	4.7	4.6	9.8
4	5.4	175	....	5.4	....	5.4
5	7.3	167	....	6.9	0.4	7.3
6	4.0	166	0.5	3.5	....	4.0
7	2.4	162	....	2.4	....	2.4
8	5.6	144	....	....	5.6	5.6
9	1.4	140	....	1.4	....	1.4
Sub total	48.6	187	6.1	31.9	10.6	48.6
						All Weather Surf.
10	6.5	137	1.4	5.1	....	6.5
11	3.3	136	3.3	....	....	3.3
12	3.6	135	....	3.6	....	3.6
13	3.9	133	....	3.9	....	3.9
14	4.6	133	....	4.6	....	4.6
15	6.8	128	....	6.8	....	6.8
16	5.5	126	....	5.5	....	5.5
17	8.8	119	....	8.8	....	8.8
18	2.7	119	....	2.7	....	2.7
19	3.2	116	....	3.2	....	3.2
20	2.8	112	....	2.8	....	2.8
21	4.6	112	....	4.6	....	4.6
22	1.5	110	....	1.5	....	1.5
23	3.6	105	....	3.6	....	3.6
24	4.2	91	....	4.2	....	4.2
25	4.7	91	....	4.7	....	4.7
26	3.1	88	....	3.1	....	3.1
27	3.0	87	....	3.0	....	3.0
28	1.8	84	....	1.8	....	1.8
29	4.2	84	....	4.2	....	4.2
30	8.2	76	2.5	5.7	....	8.2
31	2.9	75	1.6	1.3	....	2.9
32	6.8	68	....	6.8	....	6.8
33	3.4	61	....	3.4	....	3.4
34	6.8	60	....	6.8	....	6.8
35	7.3	58	6.3	1.0	....	7.3
36	11.4	57	4.8	6.6	....	11.4
37	9.2	55	2.4	6.8	....	9.2
38	6.8	49	....	6.8	....	6.8
39	5.8	45	2.7	3.1	....	5.8
40	4.9	42	....	4.9	....	4.9
41	7.2	40	3.5	3.7	....	7.2
Sub total	163.1	86	28.5	134.6	....	163.1
Grand total	211.7	273	34.6	166.5	10.6	211.7

Guadalupe County Road Improvement Plan Roads with Low Traffic Volume Selected as Desirable Connections

Traffic Priority	Average 24-Hour Traffic	Vehicle Miles	Length Miles	Present Condition — Unimproved	Present Condition — Metal Surf.
42	36	115	3.2	....	3.2
43	35	196	5.6	....	5.6
44	33	142	4.3	1.2	3.1
45	26	169	6.5	3.8	2.7
46	21	204	9.7	6.6	3.1
47	20	78	3.9	3.0	.9
48	17	44	2.6	....	2.6
49	17	77	4.5	3.5	1.0
50	16	37	2.3	2.3	....
51	15	30	2.0	....	2.0
52	15	48	3.2	3.2	....
53	12	46	3.8	3.8	....
54	5	11	2.2	2.2	....
	22	1197	53.8	29.6	24.2

Typical Texas County's F. A. Program

Of timely interest for its factual data as well as the manner of presentation is the following outline of the suggested secondary program worked out for Guadalupe County, Texas, as transmitted by a letter from D. C. Greer, state highway engineer, to County Judge H. A. Heideke:

Guadalupe County (County seat, Seguin) has a population of 25,596; 7,379 live in two incorporated cities and 2,234 in 14 smaller communities; 15,983 in strictly rural areas.

As of 1941 the Road Inventory Traffic Tables show a total county road mileage of 806, classified as follows: Earth roads, 354 miles (average daily traffic 13); metal surfaced roads 420 miles (traffic 71); paved roads 31 miles (traffic 536). There are now 110 miles of State Highways which carry 79% of the total traffic. The tabulation herewith shows the miles of road to be improved, present condition, the traffic now using, and recommended improvement.

The roads are listed in order of traffic priority and are identified on the map by their priority numbers. Roads numbered 1 through 9 are recommended for a bituminous surface; the remaining mileage for a gravel or caliche surface.

The recommended improvement consists of 48.6 miles to be hard surfaced (average traffic of 187); 163 miles to be improved to the graded, drained and all-weather surface status (traffic average 86). Upon completion of this improvement 70% of the strictly rural population and 81% of the total population would be directly served by all-weather roads.

The roads selected for improvement carry 69% of the total county road travel and upon completion of the improvement 94% of the total traffic would travel on all-weather roads, including the State highways.

In addition to the above, the map shows 53.8 miles of low-traffic roads which would make desirable connecting links between the communities. The present volume of traffic on these roads does not justify expenditures of funds for improvement at this time, but the roads have been selected as part of a long-range program.

Secondary Standards Proposed in Michigan

TYPICAL of recommendations being prepared by local official groups for Federal-aid secondary roads in the various states, are those suggested recently by a committee of the County Road Association of Michigan. Their proposal is as follows:

1. That monies available to Michigan be divided between the state highway department and the county road commissions in the same proportion as in the last Secondary program (27% state, 73% county).

2. That county money be divided between the 83 counties, ⅓ in proportion to county road mileage, ⅓ to population, ⅓ to area.

3. That any money not matched be redivided between the participating counties, if they are able to use it; otherwise to be given to the state highway department.

4. That the Federal-aid secondary system be extended to include 40%, maximum, of the total county road mileage, and all bridges, regardless of location on the approved system.

5. That specifications be prepared for three types of secondary roads. (A) Concrete or other high type, (B) bituminous surface treatment or retread on gravel base, (C) low cost gravel.

6. That the amount of detail planning be held to the absolute minimum required, consistent with the type of road to be constructed.

7. That minimum requirements be reduced to permit a more general participation in the program, and be established as follows:

	Type A	Type B	Type C
Curvature radius	1000 ft.	500 ft.	300 ft.
Grade width	28 ft.	26 ft.	24 ft.
Surface width ..	20 ft.	18 ft.	16 ft.
Slopes, inside ...	1 on 2	1 on 2	1 on 2
Sight distances .	500 ft.	300 ft.	200 ft.
Gradient	7%	10%	12%
Culvert size	15 in. (No Hdw.)	12 in.	12 in.

Members of the committee were Fred F. Rogers, chairman; Claude Stover, E. D. Crandall, E. E. Ferris, Carl Bowen and J. N. Sloan.

Practical Problems Raised

Commenting on the proposals, Mr. Rogers had the following pointed comment:

"If there is any merit to Federal aid for roads, it is to assist the 'have not' states and counties at the expense of the more prosperous, in order to perfect a more uniform system of highways.

"It follows, then, that in applying Federal aid to secondary roads, the standards and methods of performing the work, must be such as to make it possible for the poorest counties to participate in the plan.

"The poorest counties in Michigan happen to include those that have the most severe winter maintenance problems. Snow removal is an operation which cannot satisfactorily be let by contract, nor can it be done by a county organization that does not exist the year around. Equipment and manpower required for winter maintenance must be provided with all-year work.

Snow Costs Eat Funds

"The funds available to the poorer counties are not sufficient to maintain a year-around organization any larger than is required for snow removal, and therefore any funds available for construction or improvement work must be used on a force account basis. How, then, are these poor counties to participate in Federal aid if the only funds they have for matching are required to finance a minimum organization?

"The type of construction which these counties need is of low standard, and can be done very economically and satisfactorily by force account work, and mostly with local materials.

"If we include these light-traffic roads in the Federal-aid secondary system, specifications must be drastically lowered. In my own county, we have improved over two hundred miles of this type of road, without surveys or detail plans. Modern equipment makes this possible. The public wants many miles at low cost, and they are paying the bill regardless of whether local, state or federal funds are being used.

"In building these roads it is not desirable to look forward to the time when a better-than-gravel surface may be required. The vast majority of these roads will always be low-traffic roads."

Secondary Notes from Other States

BRIEF excerpts from letters from state highway leaders:

Oklahoma. Will endeavor to hold standards down to insure maximum mileage. Legislature just hiked gas tax 2 cents for matching revenue.—H. E. Bailey, Chief Engineer.

New Hampshire. Anticipates no change in design standards long used on town roads.—F. E. Everett, Commissioner.

California. Progressing with definition of urban boundaries and other details. Div. of Highways considering

formation of secondary road department.—**Fred Grumm, Asst. State Hwy. Engineer.**

W. Virginia. (State has jurisdiction over all roads.) "The improvement in standards and higher requirements have been going forward for a number of years. The result has been the expenditure of a large part of Federal-aid funds in the reconstruction, relocation and improvement of fairly adequate existing highways. It is our hope that postwar funds available for secondary roads may be expended on those of lesser importance in order to provide all-weather transportation, even if the standards for such roads are low. For this reason we are attempting to secure approval of a secondary system which will reach down to the level of the so-called farm-to-market roads serving agriculture, mines, school and buses, mail carriers, etc.—**M. L. O'Neale, Chief Engineer.**

New York. The needs in New York in some instances would conform with our old so-called Farm-to-Market roads; in other cases as high as 20 ft. of concrete. Our secondary road system is viewed as of a great deal less comparative importance than it is in a great many other sections of the country.—**H. O. Schermerhorn, Acting Chief Engineer.**

Georgia. Has running start, administratively. "Our department's Post Roads Division was created in 1937 for the sole purpose of developing a Secondary and Farm-to-Market-Road program and to administer and direct operations between the State and the Counties with respect to the construction only, of roads in the Secondary System, and in the counties not on the State System. F. P. King is Director."—**Roy A. Flynt, State Dir., Div. of Highway Planning.**

Maryland. The commission prior to the 1944 federal act asked county boards for secondary programs and thus made an early beginning. County matching funds can be instituted through legislation just enacted. Flexible design approach to be followed.—**Wilson T. Ballard, Chief Engineer.**

Kentucky. We have met with a County Judges committee, questionnaired County Judges for lists of projects, and contacted Farm Bureau Federation, Letter Carriers' Assn. and State Board of Education for suggestions. It is our endeavor to combine various suggestions . . . build a long-term secondary program.—**T. H. Cutler, State Highway Engineer.**

Wisconsin. Considering a 13,000-mile secondary system, made up of 4,500 miles of trunk highways not now on the F.A. system and 8,500 miles or about 10% of the local roads. Funds to be allocated to counties 40% in ratio of motor registration, 60% on mileage. Anticipate that trunk line standards for under-200 traffic (24-ft. surface, 28-ft. earth roadbed) will be generally adaptable.—**E. L. Roettiger, State Highway Engineer.**

Maine. "Our recommendation . . . mostly for gravel roads, with treated gravel 18 ft. wide where traffic runs up to 500 cars a day, and bituminous mixed-in-place or plant-mixed surface 20-22-ft. wide for heavier traffic. Grades of 9 or 10%, however, may be necessary. We honestly feel that conditions surrounding these secondaries do not justify the immense expenditure that would be necessary to reduce grades and curvature in many cases." **L. D. Barrows, Chief Engineer.**

Kansas. "Commission has set up a Secondary Road Department. New senate bills (306 and 147) establish a secondary system and enable state to match funds."—**R. C. Keeling, State Highway Engineer.**

Colorado. "Width, sight distance, etc., will be determined by terrain and traffic volume. We do not have sufficient funds to match the federal secondary allocation."—**A. F. Hewitt, State Highway Engineer.**

Nevada. "Expect to have a partial system selected by midsummer to utilize first two years' funds. Sufficient state matching funds in reserve. Not department's intention to have hard and fast design standards but make each road stand on its own merits. A 22-ft. graveled road, minimum all-weather design."—**H. D. Mills, Asst. State Hwy. Engr.**

Washington. "The local engineering organizations will be used to greatest extent possible in plans preparation and construction of secondary roads. Most counties now have surplus funds available for this use."—**Clarence Hickey, Director of Highways.**

Missouri. "Since 1928 the state has construction maintenance jurisdiction over a 'supplementary' system of 8,000 miles. The F.A. secondary program will permit enlargement of this system. Continuous study is made of the system as laid out in the counties and additions and revisions of future routes are progressively made to insure maximum service at least cost in all counties. The major factors taken into consideration on this study are service to rural units and industries, cost of construction, traffic objectives such as towns and shipping points, volume and type of traffic, division of territory, rural mail service, school bus service and coordination of the system. The attached chart indicated tentative design standards. These, of course, are subject to revision."—**S. M. Rudder, Asst. Chief Engr.**

N. Carolina. "Recently designated over 6,000 miles of county highways as an F.A. secondary system. Our purpose to locate these as near present locations as possible, build to reasonable standards with some light-type treatment."—**W. Vance Baise, State Highway Engr.**

Design Standards for Supplementary Roads
(As Used in Missouri in Recent Years)

	Less Than 50 Vehicles Per Day	50 to 100 Vehicles Per Day	100 to 600 Vehicles Per Day
Design speed M.P.H.	25	30	35-45
Roadway width (finished section)	20	24	26-30
Surface width	18	20	20
Curvature	30°	19°	10°-4°
Gradient (maximum)	15%	12%	10%-6%
Bridge width (new construction)	20	20	22-24
Right of way width	60	60	80-100
Non-passing sight distance	140	180	230-320
Passing sight distance	500	500	800-1300
Ditch depth below shoulder	1'0"	1'0"	2'0"
Inslopes	2:1	3:1	3:1-4:1
Cut slopes	1½:1	1½:1	{ 2:1 up to 10' { 1½:1 over 10'
Fill slopes	1½:1	1½:1	2:1

Standards for less than 50 cars and 50 to 100 vehicles per day are minimum only. Non-passing sight distance for 4.5' and 4". Passing sight distance for 4.5' and 4.5'. Cut slopes shown for earth excavation only.

California Road Costs Summarized

Weighted average contract prices for state highway construction in California in recent years are summarized in the 14th annual report of the division of highways as follows:

	1920	1938	1939	1940	1941	1942	1943	1944
Grading (all classifications) per cu. yd.	$1.10	$0.29	....	....	....	....	....	....
Roadway excavation (without classification) per cu. yd.	....	....	$0.29	$0.22	$0.26	$0.35	$0.42	$0.50
Asphalt concrete, per ton	....	2.84	2.94	2.97	3.18	4.16	4.76	4.50
P. C. concrete pavement* (Class "A" 6 sacks), per cu. yd.	16.25	8.00	7.58	7.44	....	....	....	....
P. C. concrete pavement* (Class "B" 5 sacks), per cu. yd.	....	7.33	6.88	7.68	7.54	9.62	11.48	10.46

*Does not include reinforcing steel.

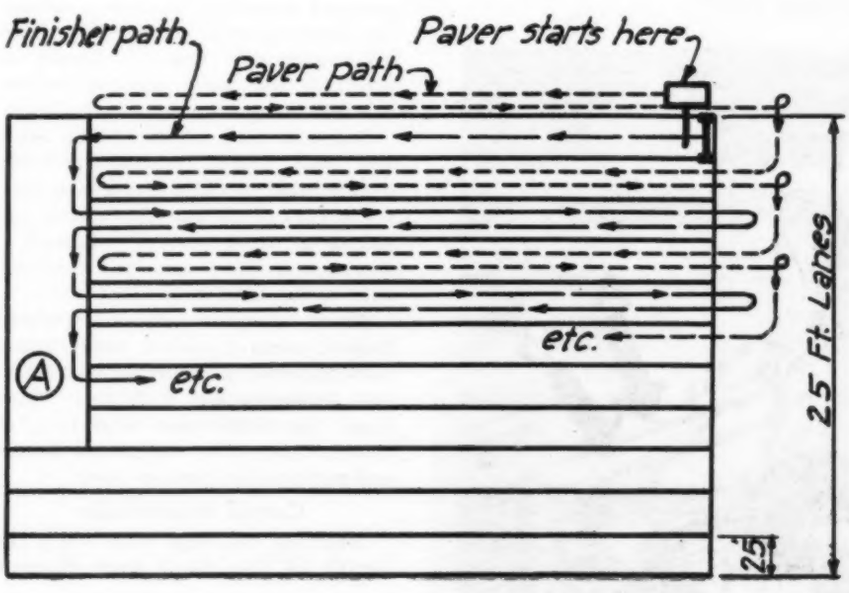
JOB and EQUIPMENT IDEAS

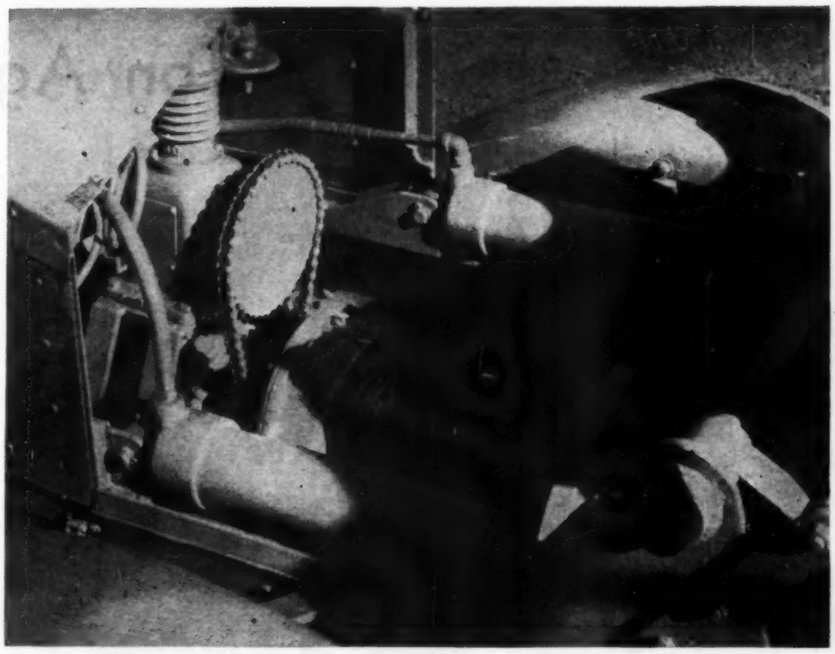
Send in your contributions to this idea exchange and help road building progress.* ROADS AND STREETS *will pay a minimum of $5.00 each for any publishable field or office methods or shop kinks. Why not pass this along to your staff and encourage them to send in brief "how we did it" descriptions, rough sketches or snapshots

One Way to Shift Finishers On Apron Paving

Just as sure as an airport apron is concreted in lanes, the contractor is irked by the difficulty of shifting his finishing equipment a lot of times. The traditional method is to run the spreader, finisher and joint machine off onto skids and skew or drag them to the new position. Which eats up time and manpower and doesn't seem very efficient and in fact isn't.

One interesting variation among the many solutions is described by W. V. Wright of L. H. Lacy Company, Dallas contracting firm. The accompanying sketch is strictly a "back-of-an-old-envelope" job but it shows the general idea this firm used at the Abiline (Tex.) Army Air Base job. The rectangular area "A" indicates an existing concrete apron strip, which was too narrow to allow the usual turning around of a 25-ft. finishing outfit. The new lanes shown were paved in the usual alternate sequence. The paver progressed toward the existing "A" slab in each instance, then backed out and came on the next alternate lane. The finishing equipment, meantime, as each lane was completed, was shunted onto dollies on the "A" slab, moved laterally to the new lane without turning, then backed the full length of the lane and out on an extension form section on the outer end, where it was ready to begin finishing again.





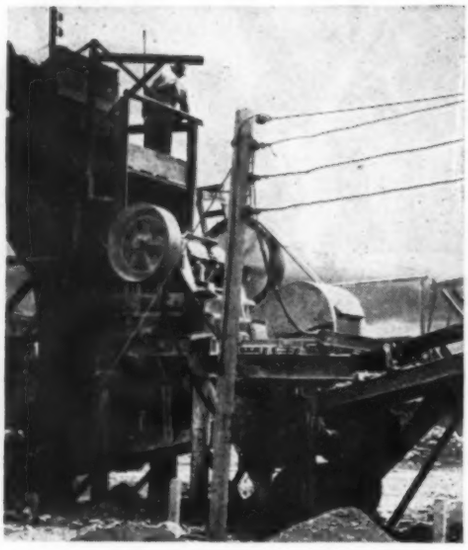
Compressed Air for Windshield Wipers on Snow Plows

"Our experience has been that only the windshield wipers actuated by compressed air have enough power and will stand up on snow removal work in the California mountains," writes R. H. Stalnaker, Equipment Engineer, Calif. Div. of Highways. "Since our Snogo plows are powered by Climax engines without provision for compressor drive it was necessary to install a compressor under the hood and improvise the drive shown in the picture. It is used in furnishing air for an 'air push' wiper.

"Incidentally, the receiver for this compressor is also shown in the picture. It is simply a piece of double-strength pipe with the ends closed, serving to smooth out the pulsations in the air supply.

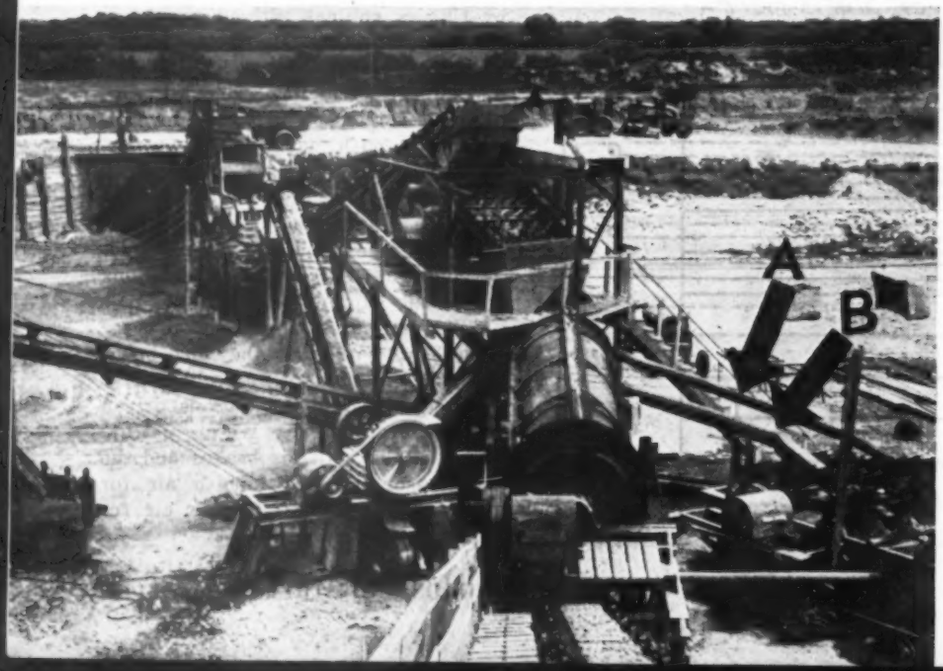
"We are purchasing some new rotaries this year, but they are being mounted on standard four-wheel-drive truck chassis and the plow is driven by a separate engine. We are getting these trucks with air brakes and the compressor used to furnish air for the brakes will also furnish air for the windshield wiper."

200-Ton Aggregate Plant



(Left): Secondary jaw crusher which receives oversize and sends recrushed material back into line via belt in background. This and all other crusher, conveyor, shaker and screen units have individual electric motor drive. (Right): Primary crusher fed from grizzly which by-passes minus 2½-in. material onto belt

Plant as seen from a point on the gravel stock-pile conveyor. Pipe "A" discharges water from the shaker screen above, water being piped through the stock piles to a creek. Pipe "B" carries wet sand to sand screen at right



DESIGNED primarily to produce aggregates for 560,000 sq. yd. of heavy concrete pavement extension at Randolph Field, Texas, the crushing and screening plant pictured here embodied a production line as follows—see figure.

Material from a nearby gravel pit was dumped through a grating into a hopper (1), this element including a shop-made plate feeder. A belt conveyor unit (2), delivered to a grizzly (3) which fed material to an 18x36-in. primary crusher (4). A second conveyor unit (5) then fed crushed material to a double-deck 5x14-in. shaker screen (6).

At this point material when wanted was diverted to a lateral belt (7) and thence into a loading bin (8) for use in base construction. Caliche was used for this purpose. The change involved cutting out water and changing screen size. This belt was not in operation most of the time, as base materials were produced mainly at another plant.

To continue with the regular aggregate production set-up, oversize screened materials fed into a secondary 10x24-in. jaw crusher (9), from which recrushed material passed up belt (10) and back into the line on belt (5).

Screened material other than oversize next passed into a revolving gravel washer (11), going via conveyor (14) to the gravel stockpile and separated sand passing through a sandwasher (12) and up conveyor (13) to the sand stockpile.

Seven electric motors, operated from a central control tower room, were required as indicated by (M) in the accompanying drawing. Three large clamshells were kept busy at the stockpile filling the loading hopper and performing cleanup work.

Careful Maintenance

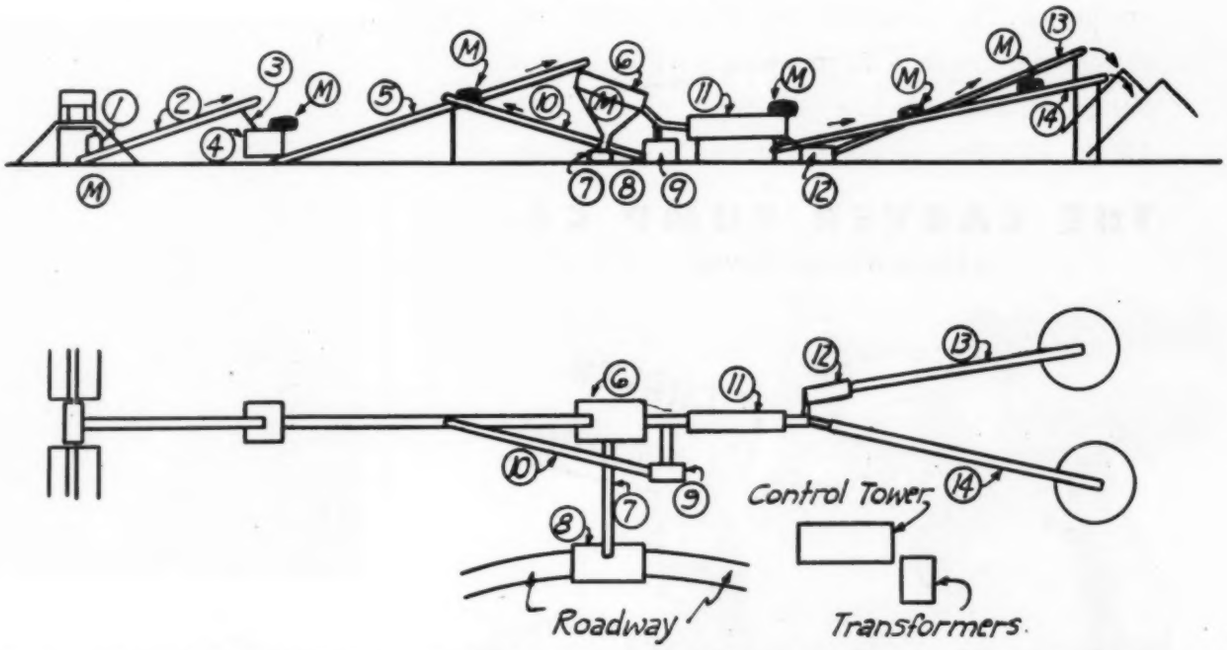
Matching the care with which the details of this plant were planned,

for Randolph Field Job

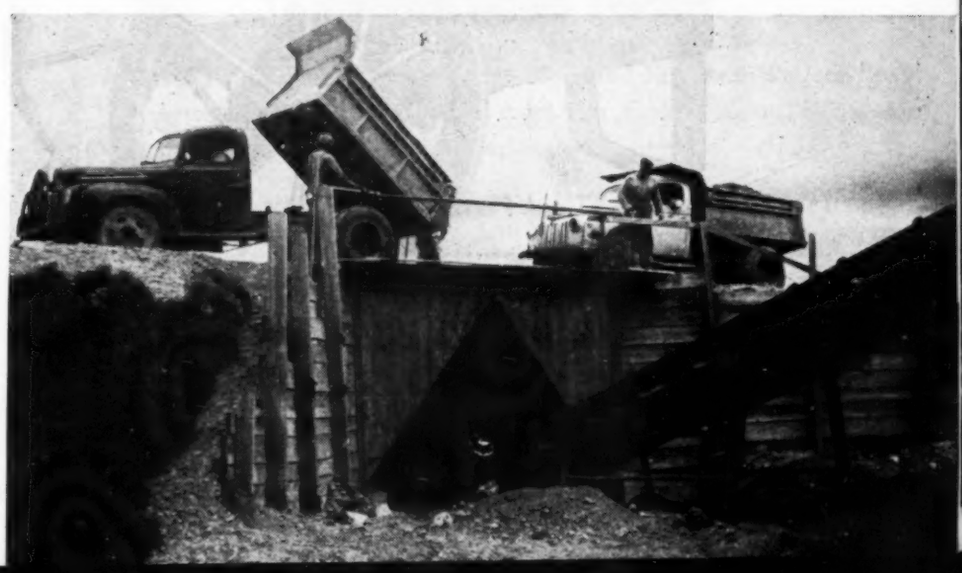
was the maintenance routine set up for it during the months of operation. The contractor assigned a grease truck and two mechanics for servicing this plant and a separate 300-ton-per-hour diesel-operated base ballast crushing-screening plant also on the project. These men went on nightly at the end of the day's run and greased and inspected, and if necessary repaired or adjusted, all moving parts "according to the book." During the day one man put in full time as a mechanical watch dog and general serviceman. According to C. A. Chipley of the contracting firm, the most important step in running a crushing and screening plant is to hire an operator who knows how to run and maintain equipment of this kind—one who has an eagle eye, sharp nose and keen ear for the condition of bearings, shafts, chains, bands, etc.

The 9-man crew here consisted of a shovel and dozer operator in the pit, three men on the dump, one each on the crushers, control tower and plant in general, and an overseer.

This plant was part of the equipment of M. B. Killian & Co., and E. B. Darby & Co., Texas, firms which jointly hold the general contract for 1945 extension work at Randolph Field.



The dumping hopper wasn't a bottleneck here. Trucks dumped through a grating in a ramp roadway circling directly back to the adjacent pit. No backing or turning around



G. T. Seabury of Am. Soc. C. E. Is Dead

George T. Seabury, secretary of the American Society of Civil Engineers since Jan. 1, 1925, died May 25. He was 65. He was to have retired as secretary June 1, his successor being Col. William N. Carey, chief engineer, Federal Works Agency. Mr. Seabury after graduating from Massachusetts Institute of Technology in 1902 with the degree of B.S. in C.E., entered the field of heavy engineering construction, serving several construction corporations in New York City, including the Subway Construction Co., the O'Rourke Engineering and Contracting Co., the United Engineering and Contracting Co., and I. C. Rodgers Co., now Rodgers & Haggerty. His activities included work on construction of Grand Central Terminal and Riverside Drive, New York City. From 1906 to 1915 Mr. Seabury

G. T. Seabury

was an engineer for the Board of Water Supply of New York City, working on the Ashokan reservoir and dam, and later on the Kensico reservoir and dam near White Plains, N. Y. In 1915 he was appointed division engineer in charge of $18,000,000 of construction for the new water supply system in Providence, R. I.

During the first World War he served as a major in the Army's quartermaster department, supervising construction at Camp Devens, Upton, Mills, Merritt, Dix, Meade and Lee. He established George T. Seabury, Inc., a firm specializing in heavy construction in New England, in June, 1918, and was its president and general manager for four years. In 1923 and 1924 he was manager of the Providence Safety Council.

Highway Subdrainage and Base Drainage

A discussion of past mistakes and suggestions for effective drainage as presented before the 6th Annual Highway Conference, University of Utah

By HARRY E. COTTON

Drainage Engineer, Armco Drainage Products Assn., Middletown, Ohio

ALL engineers agree that drainage is the first important item in highway construction and some have gone so far as to give it first, second and third place combined. With this seemingly universal opinion prevailing, why does subdrainage lag far behind other phases of construction? This is a difficult question to answer but here are a few thoughts on the subject:

1. Lack of subsurface information in the design department.

2. Lack of confidence in subdrainage probably due to previous bad experience with drains which were misplaced or poorly constructed.

3. Lack of knowledge as to how to obtain effective subdrainage.

4. The overworked blue pencil of the department head. Subdrainage is often the first item eliminated when the estimate exceeds the budget. Also a tendency often prevails to eliminate those items which do not show on the surface.

5. Too few engineers give water credit for being the chief enemy of pavements.

6. Too many are of the opinion that good foundations can be obtained in the presence of excess moisture. Stabilization by manipulation of soils has first place in many a designer's mind when it should be stabilization by the removal of water.

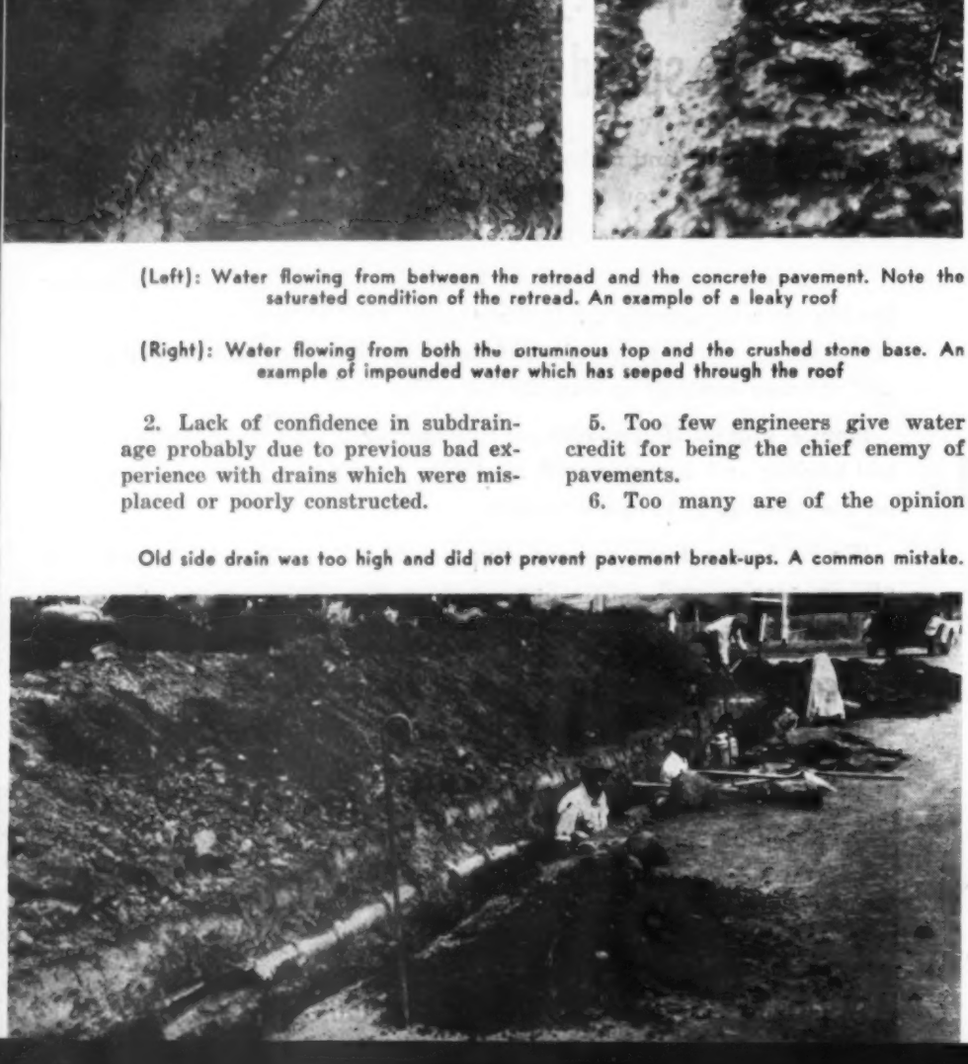
7. Lack of appreciation of the fact that a pavement is no better than its foundation.

The purpose of this paper is to point out some of the mistakes made in the past and to suggest ways and means of obtaining effective subdrainage.

(Left): Water flowing from between the retread and the concrete pavement. Note the saturated condition of the retread. An example of a leaky roof

(Right): Water flowing from both the bituminous top and the crushed stone base. An example of impounded water which has seeped through the roof

Old side drain was too high and did not prevent pavement break-ups. A common mistake.



Two Moisture Sources

In approaching the problem of eliminating excess moisture which may damage the foundation, we must realize that water may reach the foundation either from the surface, commonly called roof leakage, or from ground water. There are many cases where the moisture in the subgrade is from both sources. Conclusions as to the source of water causing pavement breakups must not be made on the basis of visual surface examination, but must be based on an examination of the base, the subgrade soils and the existence of free water zones within effective capillary rise depth. The real source is often determined by the process of elimination.

Roof leakage causes mud pumping and weak foundations. Water enters through joints, cracks and at the edge of the pavement and most pavements leak during a good portion of their life. Damage from roof leakage occurs when the foundation or subgrade is impervious and there is no exit for the water. Impervious subgrade soils are found in all states but are more prevalent in the prairie states. The solution for roof leakage is a pervious base with base drainage.

Capillary water causes frost heave and weak foundations. Its source is usually from a free ground water zone which may be either the so-called level water table condition or a sidehill seepage condition, the former requiring a drain on both sides of the pavement while the latter requires a drain on the side from which the seepage flows. When roads are located in a valley, seepage may exist from both sides. Level watertable conditions are found in level terrains and mostly in swampy locations. Side-

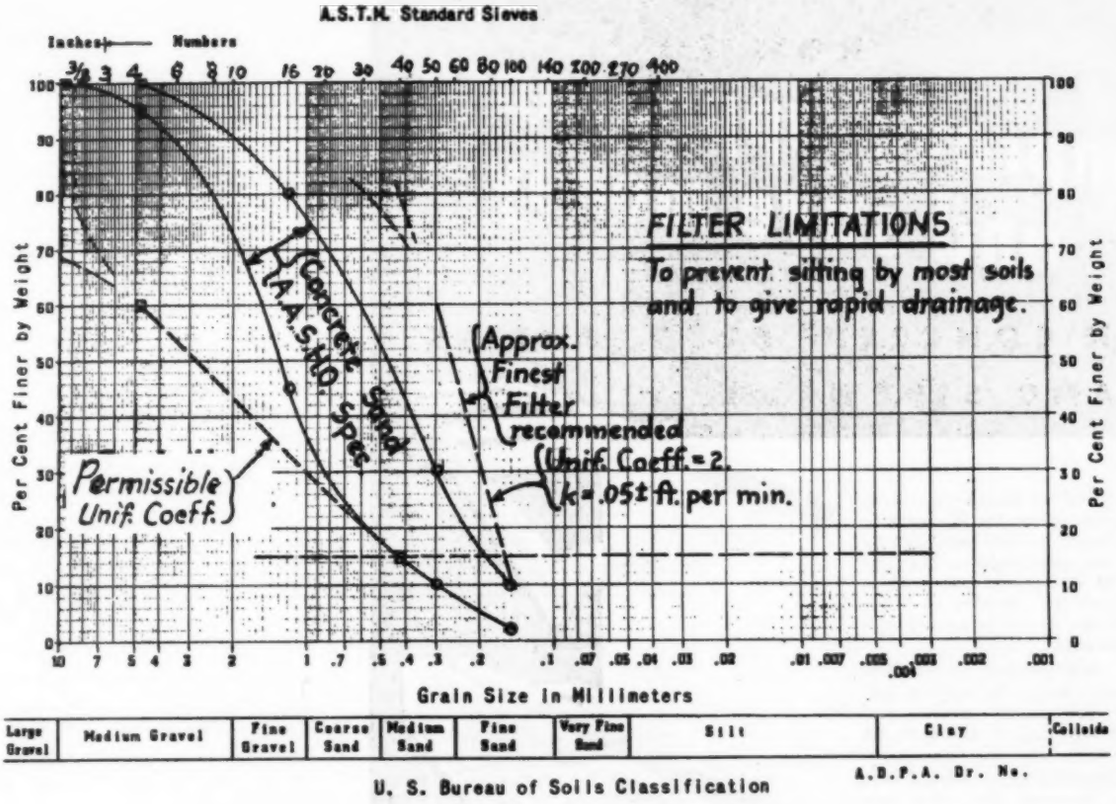
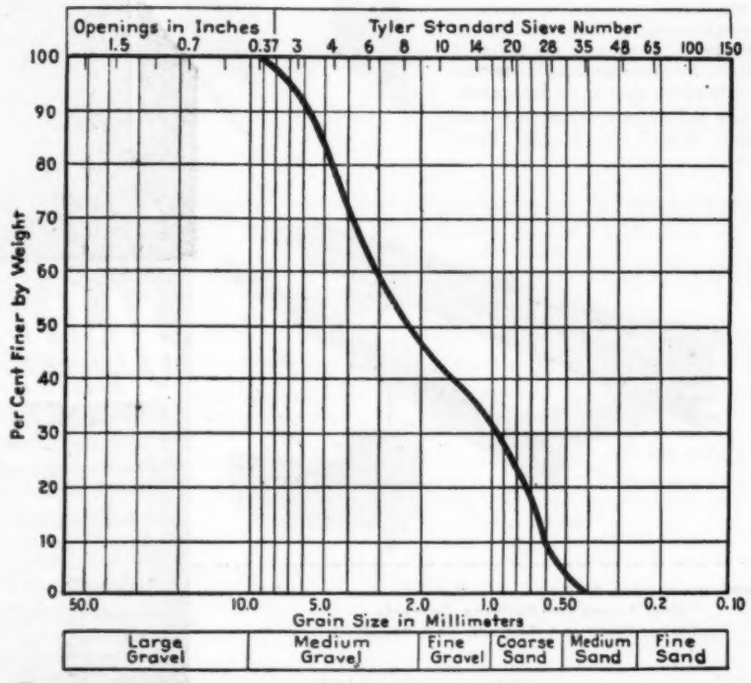


Fig. 1

hill seepage is the usual condition found in all states. Because of the difference in geological formations and the amount of rainfall, seepage is much more common in some states than in others. In the New England States, nearly all cuts are wet from seepage, and in many cases subdrainage is required before the contractor can complete the grading.

Some Common Mistakes

Errors in the past have been numerous and in many cases can be classed as ridiculous. Side drains (or intercepting subdrains) have been known to be placed on the wrong side of the road. The most common error is lack of depth to accomplish seepage interception. Not so long ago some highway departments stated in their printed specifications that side drains shall be 3½ feet deep. Many highway departments still specify a coarse backfill. Base drains have been placed in clay soil shoulders 2 feet or more away from the edge of the pavement with no pervious material connection between the base and the drain pipe. French drains (without pipe) have been and still are used profusely in places where they have no chance to live. Miles and miles of subdrains have been installed in a clay soil zone where there was no chance for a drop of ground water to reach the pipe.



Fineness curve of filter used for imbedding pipe underdrains.

Fig. 2

Herringbone drains have been used to cure frost heave where an intercepting subdrain was the answer. These are only a few of the errors this writer has observed in the field. Is it any wonder that some people question expenditures for subdrainage?

Clogging of Underdrains; Filter Materials Studied

Experience has proved that coarse backfill is definitely not a proper material to be used in subdrain trenches. Numerous uncovered drains have revealed a completely clogged condition.

Filter sands for water treatment have been studied extensively during the past 50 years. However, the results of these investigations have been but little used outside of the field of water treatment itself.*

About 1920, Terzaghi successfully used and patented in Austria a reverse filter to control the seepage under a dam on a pervious foundation.*

In 1939, Geo. E. Bertram carried out in the Soil Mechanics Laboratory at Harvard University an experimental study of filter requirements directed toward the establishment of fundamental relationships. The materials used in this investigation were uniform sizes of Ottawa sand and crushed quartz. Bertram found that stable conditions would prevail (i.e., no fines would wash into the filter) when the 15% size of the filter was not more than 8 to 10 times the 85% of the fine base material.*

In 1941, soon after receiving the assignment of building airports for the Army, the Army Corps of Engineers made at their Vicksburg Waterways Experiment Station, an investigation of filter requirements for underdrains. The following recommendations are taken from the War Department Engineering Manual, Chapter XXI, Part II, on Subsurface Drainage:

The grain size ratio,

$$\frac{\text{15\% size of filter material}}{\text{85\% size of adjacent protected soil}}$$

shall not be greater than 5 except that the 15% size of the filter material need not be less than 0.1 m.m. if the protected soil is cohesive.

To obtain a satisfactory permeability ratio, the grain size ratio,

$$\frac{\text{15\% size filter}}{\text{85\% size soil}}$$

should be greater than 5.

Also, to prevent segregation of the filter material during placement, its uniformity coefficient should not be greater than 20. Segregation can best be prevented during placement by having the material in a moist state.

The first above mentioned grain size ratio of not greater than 5 is considered by some to be too conservative. This is indicated by the Bertram tests mentioned above and also by tests made by the Soils Department of the Connecticut State Highway Department.

Practical Filter Selection

While it is theoretically advisable to test the soils and specify filters for the particular soils encountered along the proposed drain, it is to a certain extent impractical and will not usually be done. Therefore, if possible it is more practical to select a filter gradation which will perform satisfactorily for all soils or nearly

*Taken from War Department Technical Memorandum No. 183-1, commonly referred to as the Vicksburg Report.

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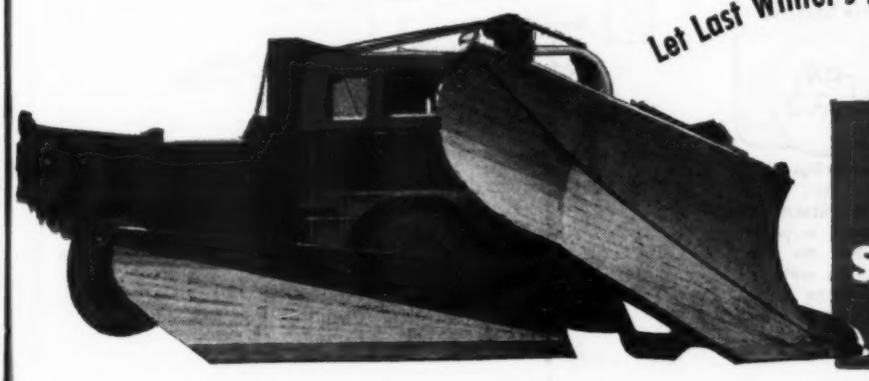

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all soils. If necessary, the specification can be varied for certain districts or even for certain types of soils. The limiting gradation shown in Fig. 1 is believed to be satisfactory for nearly all soils. The coarse size limits of the 15% size is identical with that of concrete sand as specified by the American Association of State Highway Officials. Philip Keene of the Soils Department of the State of Connecticut states that AASHO concrete sand is sufficiently fine for 99% of Conecticut soils.

Design of Infiltration Area in Drain Pipes

Since it is necessary to use a sand or a sand-gravel filter material, it is obvious that special attention must be paid to the infiltration area in the pipe (openings for water intake).

The second part of the Vicksburg experiments consisted of testing 30-ft. lengths of 6-in. pipe in a wood flume. One of the objectives was to determine the amount of filter material which would wash into the pipe. The pipe to be tested was buried in the filter material shown in Fig. 2, which is coarser on the 15% size than the average filter required. The application of water was not continued more than 20 min. as it was found that the filter material subject to washing would enter in a shorter time. The table in Fig. 3 shows the amount of filter material washed in the various pipes tested and definitely indicates the inferior design of most commercial pipe.

While the coated perforated corrugated metal pipe made a very creditable showing in the Vicksburg tests, the general results indicated that an uncoated pipe with 7/16-in. holes might not perform so well. The net diameter of the holes in the coated pipe was probably about 5/16 in. Therefore, the Armco Drainage Products Assn. conducted a series of tests

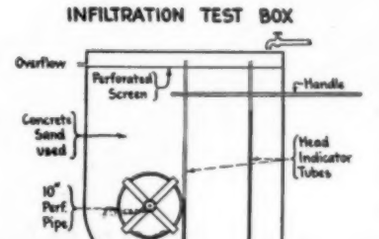
Pounds of filter material per ft. of pipe washed into test drains of various types:

Pipe	Perforations or Slots: Size (in.)	Perforations or Slots: Number per foot	Perforations or Slots: Location	Filter material washed in pounds per foot of pipe
Porous concrete, bevel joints, sections 2 ft. long	..	..	..	0.01
Porous concrete, lap joints, sections 1 ft. long	..	..	..	0.03
Perforated corrugated metal pipe coated with tar, sections 10 ft. long, split collar couplings (perforations around ½ periphery)	½	40	Down	0.03
	½	40	Up	0.2
Perforated concrete pipe, unsealed bell and spigot joints, sections 2½ ft. long (perforations around ½ periphery)	½	24	Down	1.3
	½	24	Up	2.3
Perforated clay pipe, unsealed bell and spigot joints, sections 2 ft. long (perforations around entire periphery)	½	30	..	3.7
Plain concrete pipe, unsealed bell and spigot joints, sections 3 ft. long	..	..	..	7.5
Semicircular cradle invert clay pipe, ½ in. open slot on top, unsealed bell and spigot joint, sections 2 ft. long	½	..	Top	8.4
	½	..	Top	Test void

Note: The metal drainpipe was coated with tar which reduced the area of the perforations about 50 percent.

Fig. 3

to determine the size, number of holes and number of rows of holes to give ample water intake and yet eliminate the inwash of the sand filter material. The test box used is shown in Fig. 4 (side view). The sand used complied with the AASHO specification for concrete sand. It was purposely loosely placed so that the results obtained would be exaggerated and more easily compared. The tests were started with one row of 7/16-in. holes in the bottom of the pipe. Then tests were run with the same holes placed in various positions by rotating the pipe in increments of 30 degrees until the last tests were made with the holes on top. Like tests were run with 1, 2 and 3 rows of 7/16 in. holes. Also like tests were run with 1, 2 and 3 rows of ⅜ in. holes and with 5/16 in. holes. These tests showed that the best position for the perforations is in the zone approximately 30 degrees down from the horizontal axis. Also that much less filter material entered with 5/16-in. holes than with either ⅜-in. or 7/16-in. holes. The water was applied until the entrance of sand ceased, which was a period of only a few



An investigation of position, size of perforations and number of rows of holes in Hal-Cor pipe subdrains.

Fig. 4

minutes, as was found in the Vicksburg tests. The tests also showed that the flow capacity limitations were in the sand rather than in the perforations used in this test. As a result of these tests the Armco engineers have adopted a new perforation design with either double or triple lines of 5/16-in. holes (as shown in Fig. 6).

Trench Bottom Design

Soil conditions and the objective of the drain should govern trench bottom construction. When a pipe is placed within a free water zone for

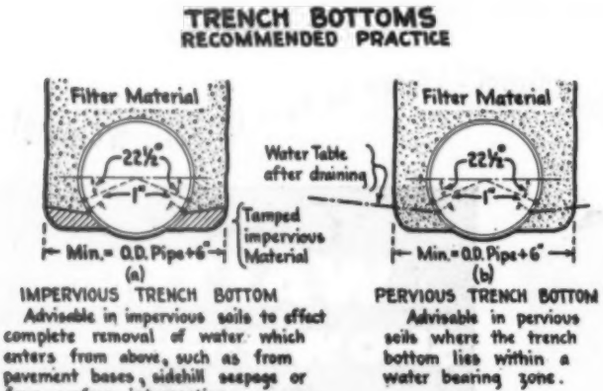


Fig. 5

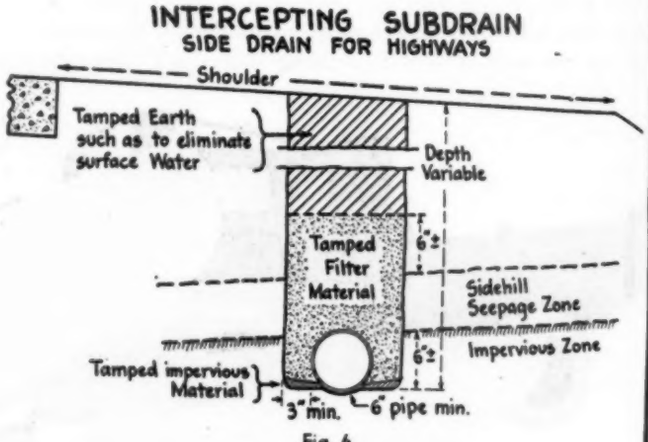


Fig. 6

the purpose of lowering a water table, the filter material should be carried up from the bottom of the excavation to allow inflow through the bottom as well as at the side. For all other conditions the trench bottom should be impervious and shaped so that all water is removed. Trapped water under the pipe causes a continuous wet condition and possible damage to the subgrade by capillary action.

Soft or mucky trench bottoms often need to be stabilized before laying the pipe. Quicksand can best be handled by tramping in straw or hay. In the case of a bad mucky condition caused by men working in water entering from above, mix in just sufficient granular material to stiffen the muck, then lay the pipe and place the impervious material as shown in Fig. 5.

(See Fig. 6.) Its purpose is to intercept and prevent seepage water from passing under the road and thus prevent the feeding of capillary water to the subgrade. Complete interception is obtained by placing the pipe slightly into the impervious zone which lays under the seepage zone. Failure to do this is a common error.

On new construction, when such seepage zones are known to exist, it must be decided whether the intercepting subdrain is necessary. This depends upon the depth and the character of the soil above the free water zone. For the average condition, when the top of the seepage zone is within

A frost heave in New England caused by sidehill seepage from the right. An intercepting sub-drain was needed on the high side only.

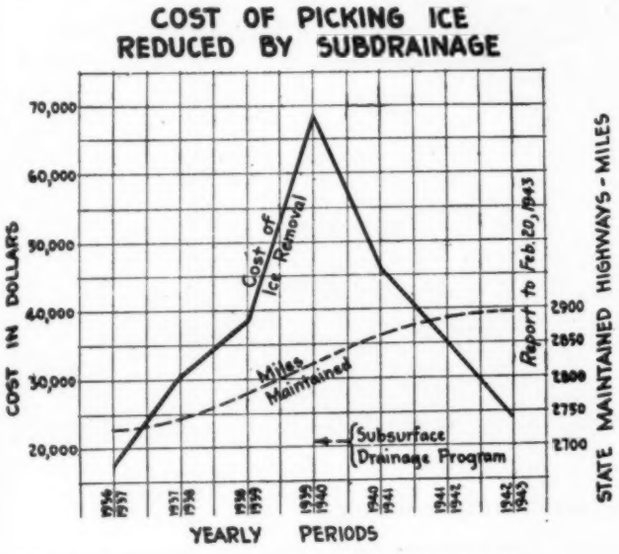


Fig. 7. From report of Connecticut State Highway Dept.

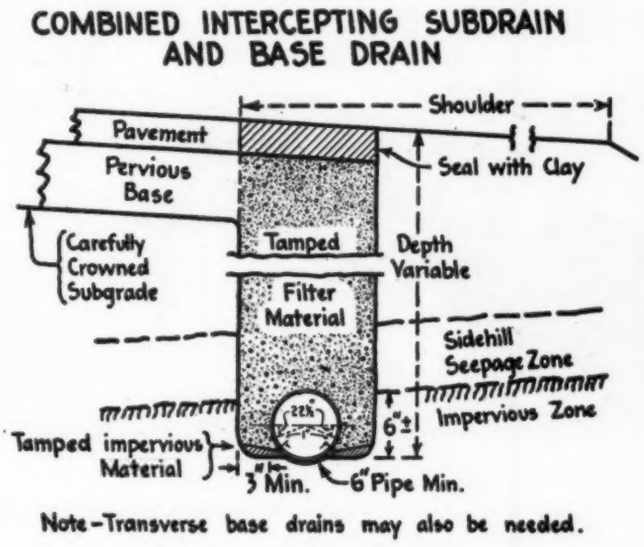


Fig. 10

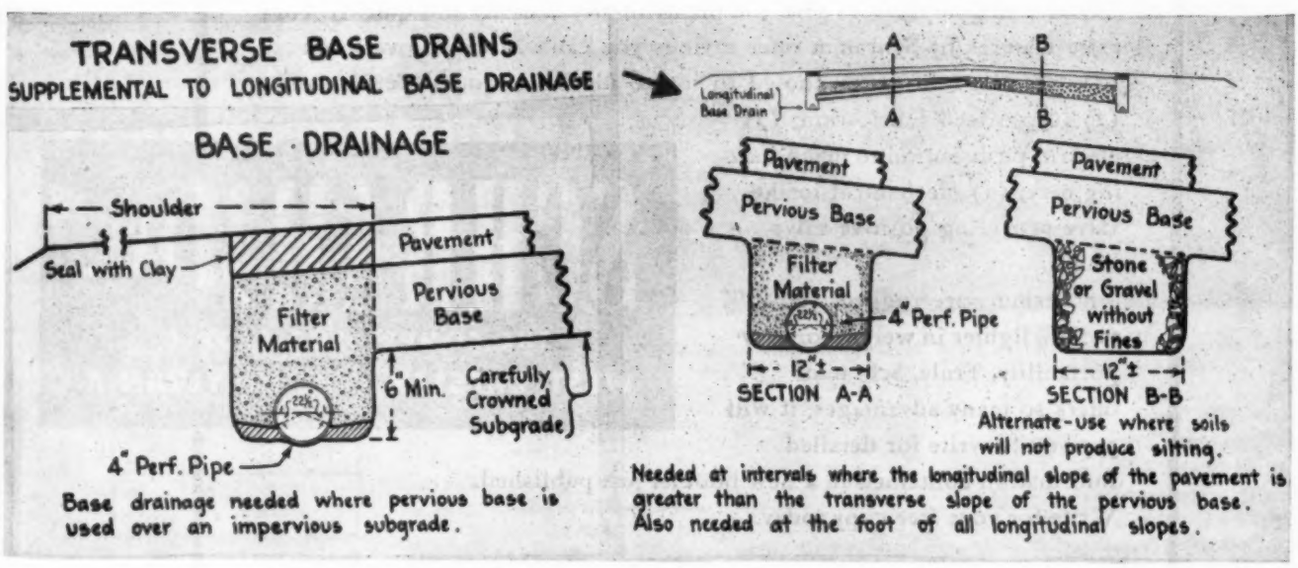


Fig. 8 and Fig. 9.—(See pages 111 and 112 for discussions of these details)

You can bet this construction job needed plenty of compressed air for rock excavation . . . and promptly Schramm Air Compressors were pulled onto the job!

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Equipment Maintenance

Does V-8 Motor Resleeving Job in 35 Minutes

This hydraulic outfit was designed and built at headquarters shop of Minnesota Highway Department

IT PUSHES out a Ford motor sleeve in 12 to 16 seconds, presses a new sleeve in just as speedily.

A complete 8-cylinder resleeving job requires only 35 minutes, including cleaning the bores.

Each sleeve is pressed *steadily* in, with a uniform, non-stop motion which eliminates formation of wrinkles, almost sure to accompany hand-operated intermittent forcing methods.

The outfit that does all this is an electrically driven hydraulic sleeve press for removing dry sleeves in motors. It was "ideaed" and built by shop superintendent Dwight Hayden and his mechanics at the Minnesota state highway department's St. Paul shop and is believed to be unique.

As pictured here the outfit consists of a vertically-held ram and a motor bed mounted within a sturdy structural frame. The elements, in detail, include the following:

(1) Ram—3-in.-diam., double-acting unit (American Hoist & Derrick) such as is seen on a variety of road equipment.

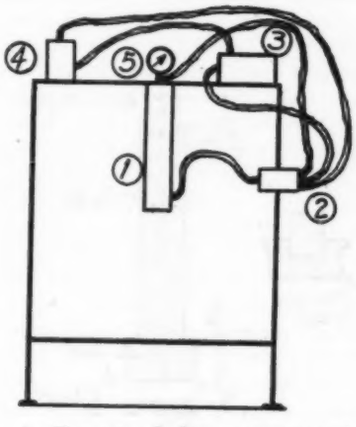
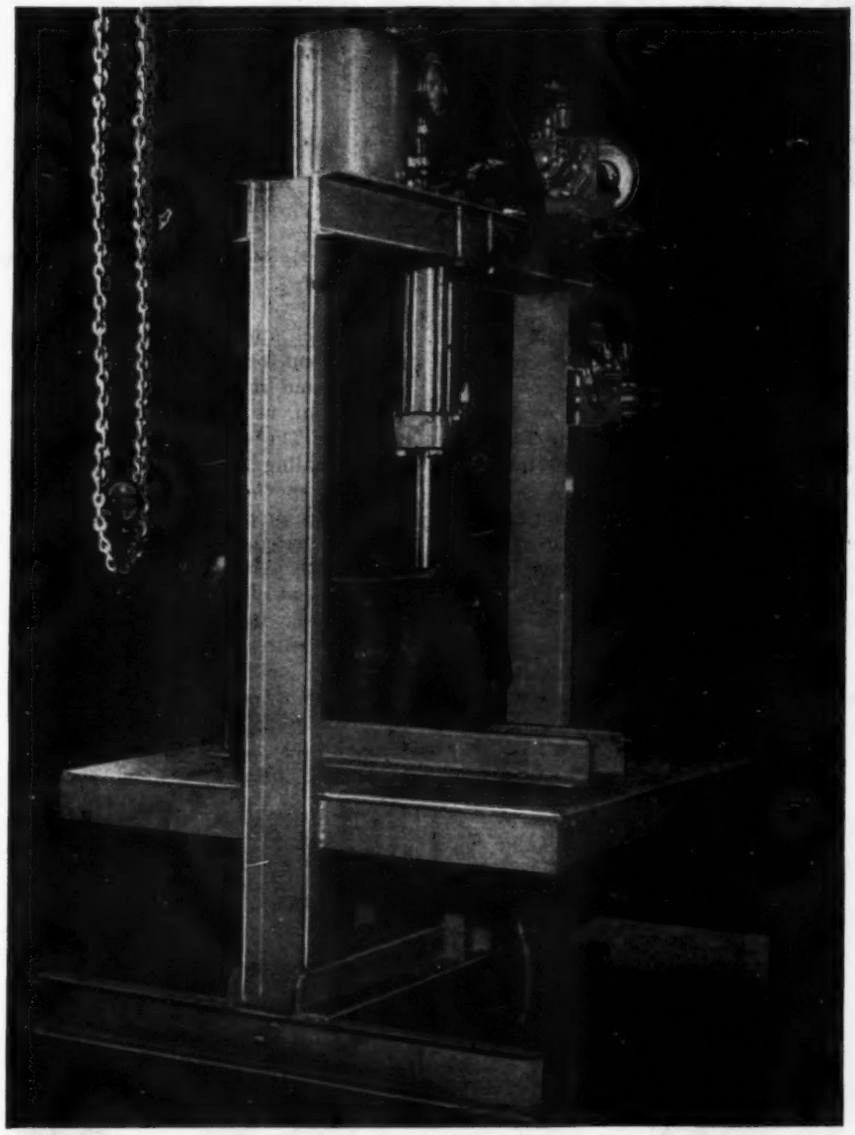


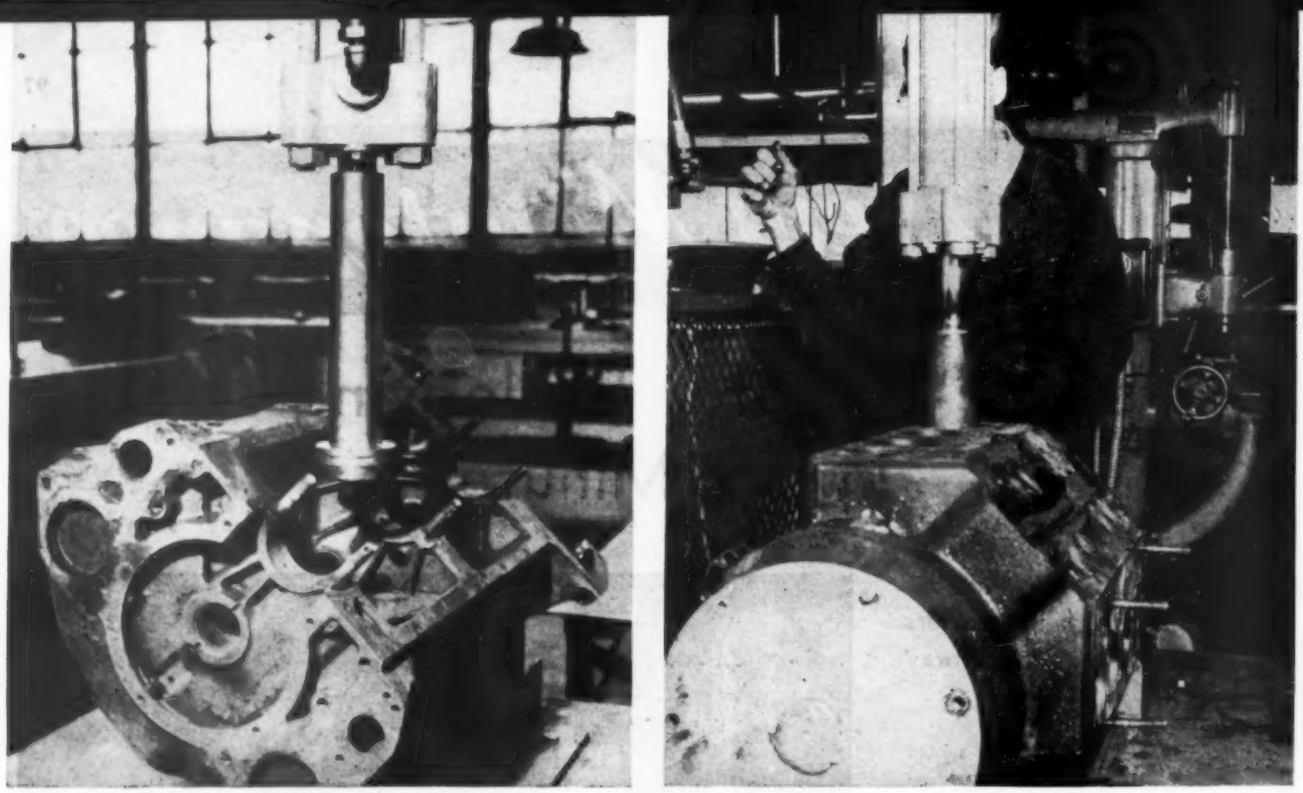
Fig. 1. Elements of sleeve press—see text and accompanying photos



General view of press showing motor sleeve being pressed out. Note that the angle iron rest holds motor high enough so that sleeves drop out beneath

(2) Valve—Blackhawk No. V-281W double-action unit, one bank up, one bank down. The valve is mounted against one column at a convenient elevation so that the operator can work the hand levers with one hand while adjusting the position of the engine block with the other.

(3) Hydraulic pump — Blackhawk No. P-104, mounted on a platform with a ¾-hp. electric motor, a V-belt drive being used with 4-1 sprocket



(Left): Head about to push out a sleeve. (Right): Motor in position for pressing sleeves into one bank of cylinders

ratio giving 515 rpm. on the pump.

(4) Reserve tank for hydraulic oil (2 gal.), connected in line between the pump and control valve as shown. Standard hydraulic hose and fittings are used throughout. SAE 30 oil has been found to work best.

(5) Pressure gauge—pressure up to 15 tons is needed to remove Ford sleeves. The capacity of the outfit is considerably higher than this, however.

(6) No Pulling Pressing heads —required to fit various models of motors as needed. These were built on the shop lathe to conventional design, as shown in Fig. 2.

This outfit has two distinct advantages, much appreciated by the short-handed shop force. One is that sleeve removal and installation are greatly speeded up, as mentioned in the beginning. The other is that freezing and wrinkling of sleeves, which are apt to occur whenever there is a pause in pressure on a hand-operated puller, are eliminated. In pressing out a sleeve the piston travels steadily downward at a travel rate of about ½ in. per sec. It pushes a sleeve in at the same rate.

Another advantage is the cylinder head anchor-bolts do not have to be removed in using this puller—a big time and labor saver.

Further simplifying and speeding up the operation of pressing in new sleeves and grinding or boring cylinder blocks is an adjustable motor support pictured in accompanying photos and in Fig. 3. It consists of a shaft of the same diameter as the engine main bearing, mounted on a channel-iron base as shown. The shaft is welded to the base. Rotating on the shaft is an end circular plate to which the motor is bolted. Holes in circular plate are so spaced that locking bolt (A) stops cylinder block in proper position for pushing in new sleeves. After resleeving of one bank is done, bolt is removed and the block turned to new position and locked with the other bank up. The support shown is designed for Ford Motors and is used for all sleeving and boring operations.

The foregoing description was supplied through the courtesy of C. L. Motl, maintenance engineer of the Minnesota state highway department.

Two-position stand for use in pressing new sleeves in Ford V-8 motor. Main bearing rests on shaft, which is welded to the base. Motor is bolted to circular end plates, which can be rotated and held by lock bolt "A" with first one bank of cylinders then the other in vertical position for resleeving

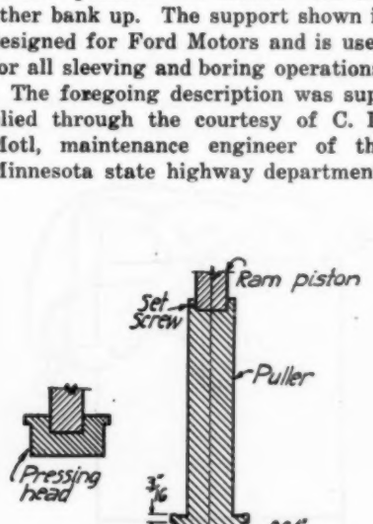


Fig. 2. Details of puller and pressing head

The How of Hard-Facing

A practice which has come into its own on wartime salvage, and is due to stay as an essential peacetime economy

By W. WESLEY MILLS,
Director of Research,
Mir-O-Col Alloy Co.
Los Angeles, Calif.

THE practice of hard-facing worn parts or wear points of construction equipment has made tremendous strides during recent war years. Specially alloyed metals, applied by welding process, provide superior wear resistance, with resulting economy of replacement and increased operating efficiency.

Leading contractors and highway department equipment engineers, who have a good opportunity to learn more about hard-facing due to shortages of equipment and scarcity of replacement parts, believe that hard-facing will continue to occupy an important place in postwar industry, long after war restrictions are fully lifted and the need for salvage is less of a factor.

What Is Hard-Facing?

Hard-facing is the use of welding to apply a layer of hard alloy metal to a softer metal part or tool in order to increase its resistance to wear. Worn parts or surfaces are also restored to original dimension and contour in the process, or to oversize or modified dimension if desired. Hard-surfacing may be deposited by the electric arc, carbon arc, or oxyacetylene process.

When Will It Pay?

This is, of course, an economic problem determined by weighing the advantages against the cost of application. Some contractors eventually may revert to the prewar habit of "not bothering" with repairs, but it seems certain that any equipment owner who looks at a few cold figures on cost of face hardening vs. cost of new parts—plus down time for parts replacement, job delays, reduction in efficiency due to operating with dull blades, worn teeth and other worn parts—either will keep facilities on hand for such work, or will see that his distributor or a commercial shop makes effective use of the hard-surfacing process.

Hard-facing of wear points on new parts or tools *before* they have been put into initial service is gaining in popularity. The cause for so treating new parts may be partially chargeable to inevitable wartime lowering of material standards, but one wonders how long equipment manufacturers will be content to see their new units "worked over" by their customers.

Some manufacturers already have adopted the practice of hard-facing the wearing parts of such equipment as grader blades and ploughshares during their fabrication, producing tougher and more wear-resistant construction at the factory. In the meantime, abrasive and frictional wear continues to be a chief mechanical problem, and every user of construction and maintenance equipment should know the facts about hard-facing and then see that his outfit is properly trained in its application.

Where Is Hard-Facing Used?

New applications are being found almost every day. In highway work, the "home ground" is in fixing parts that have to stand the gaff on earth-moving and earth and stone handling units—tractors, shovels, graders, scrapers and crushing or screening equipment. It is now common practice for restoring worn tractor idlers, rollers, track rails and pads; for putting the bite back into shovel, dragline, clam and rooter teeth; for re-edging dozer, grader, scraper, and snowplow blades; and for armoring sheepsfoot roller feet.

Less familiar to some people is its growing use on drill bits, machine tool

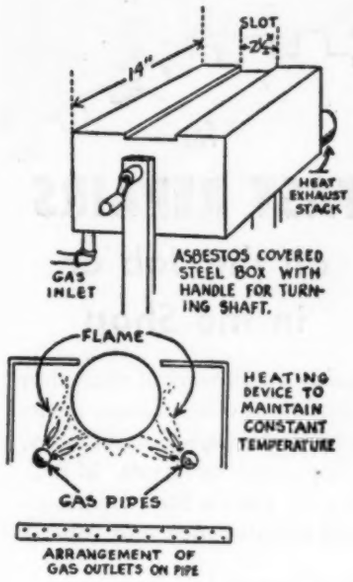


Fig. 1. How to hard-face a preheated shaft with acetylene welding after removal from furnace. Temperature to be held at 1500° throughout operation by setting shaft in a revolving cradle over flame source within a metal box as sketched. The welding operation is performed on the horizontally-held shaft through a slot in the top of the box

Building up and hardfacing of crusher jaw plates has been a "life saving" operation in wartime; will continue to be a money-saving step in peace time

cutting edges, and on costly or temporarily scarce automotive parts, such as valves and valve stems, clutch parts, rocker arms, etc. For these parts, accurate grinding and polishing are required following the hard-facing application.

What Metals Can Be Hard-Faced?

As pointed out in instructions used all over the world by the Corps of Engineers, hard-facing materials can be applied to low and medium-carbon steels with carbon content up to 0.50%; "high-carbon" steels, (over 0.50%); low-alloy steels; "manganese steels" (11 to 14%); cast iron and malleable iron.

Mir-O-Col engineers, adding stainless steels to the list, state that the following metals can be treated by the two familiar welding processes:

Mild steel—either electric or acetylene process.

High carbon steel—electric or acetylene, with pre-heating necessary before application, and heat treating afterward.

Low alloy steel—electric or acetylene (heat treatment, some alloys).

Manganese steel—electric arc process only.

Cast iron and alloy cast iron—either process.

Stainless steel—either process.

No user of the process can hope to process everything with any one type of hard-facing rod. Many types of alloys have been developed in the last 20 years by different manufacturers, to meet the various requirements for hardness, toughness, shock, abrasion and heat. The question to ask in selecting a rod is: What conditions most seriously affect the life of the surface or parts of my particular equipment? Included in these conditions are heat, corrosion, shock and impact, abrasion, sliding or rolling friction—occurring in many degrees and combinations.

An article in "The Maintenance Engineer", organ of the Corps of Engineers, classifies rod types and commercial makes available on army work in five general groups, as follows:

Class 1: Alloy cast irons and steels, containing less than 20% alloying constituents.

Class 2: Iron base alloys, over 20% alloy (such as chromium, tungsten, molybdenum, manganese, vanadium).

Class 3: Nonferrous materials such as cobalt-base alloys containing chromium and tungsten.

Class 4: Cast tungsten carbide, crushed and embedded in a high-strength steel binder.

Class 5: Diamond substitute consisting of small (⅜ in. to 1½ in. long) cast "inserts" of tungsten carbide.

Class 1 rods in general will have an ordinary degree of high resistance to wear with accompanying impact and shock. Class 5 rods, this article notes, will rate highest in wear resistance, but relatively less in impact resistance, against which rods No. 1 to 5 are most effective in reverse order, Class 1 alloys being toughest. Where precision, close tolerances and smoothness are not needed, the idea is to get a rod that strikes a balance between wear resistance, toughness and cost. Wear resistance usually comes first in facing automotive precision parts, and hence a Class 1, 2 or 3 rod is usually applied.

Class 1 or 2 rods are best on crusher jaws and rolls, where impact resistance must come first. Class 4 or 5 alloys when obtainable are recommended by army experts for field repair of blades, teeth and other wearing parts of earth-moving and stone-handling materials, drill bits, etc., where abrasion resistance is paramount. Class 2 rods, especially manganese, find wide use for these applications among road contractors.

Class 3 alloys are used extensively

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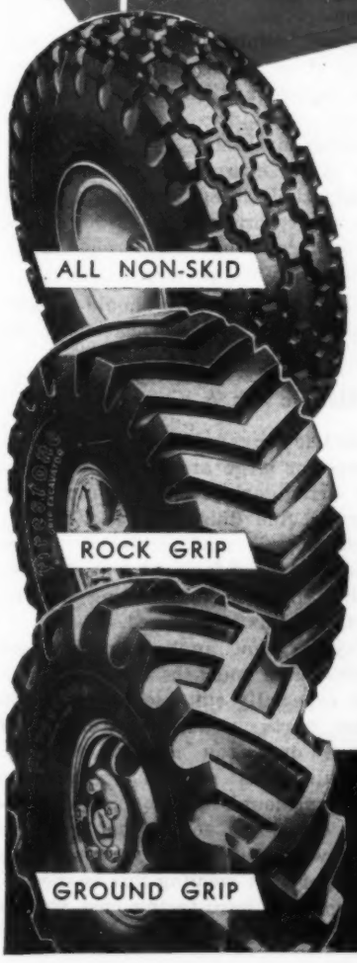

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for valves designed for resisting heat, high pressure steam, oils and acids, because of their red-hardness and corrosion resistance.

Even though the user has amassed a great deal of experience with hardening materials, he should continue to keep an eye on the manufacturer's recommendation on rod types.

How to Get Most Economical Job

The most economical work comes from considering: (a) what type of rod to use for desired qualities, (b) cost of rod, (c) material and labor cost of application, (d) percentage of deposition, and (e) likely increase in service from use of rod in question.

The type and thickness of metal in the part being hardened will govern the selection of rod size and method of application.

Next to be considered is the cost per pound of rod selected. The cheapest rod per pound may not be most economical. Amount (weight) of rod coating and expected spatter loss should be considered. A typical hard-facing material covers in the neighborhood of 20 sq. in. of surface ⅛ in. thick per lb. of rod electrically applied, or 22 sq. in. with acetylene. However, these figures will vary between commercial types and in any event are only part of the arithmetic of cost.

What the User Should Know About Effect of Welding Heat

The welder (and his boss) need to be aware of a few fundamentals here.

All metals expand with heating, and unless precautions are taken a condition called "upsetting" will often occur. This happens because the heated metal in the part being welded expands in volume as well as surface dimension. If heat is applied too intensively over a localized area, internal expansion overstresses the metal, causing either permanent warping in the case of a thin blade or other part, or raised "blisters" in the case of a heavy block. Reverse warping, checking and cracking occur when the piece cools.

Preheating minimizes "upsetting", and the shop men must learn from experience when to preheat. "Skip welding", or laying beads in alternate rows, is another means of keeping down heat concentration and minimizing the chances of upsetting or warping.

When to Preheat?

Preheating of the whole object in an oven about 1500° F. and holding throughout the welding operation is desirable. This reduces harmful internal stresses, warping and checking by partially expanding the metal before application of welding heat.

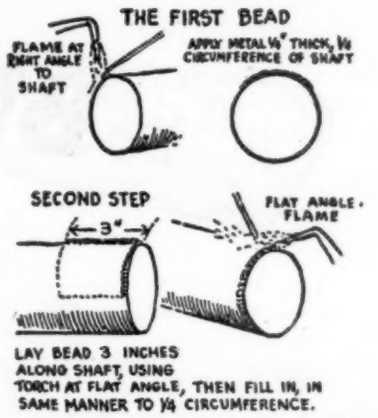

Fig. 2. Sequence of operations in hard-facing a shaft

Preheating temperatures in the case of a piece which already has been hard-faced once may need to go higher but should never be allowed to go above 1800° F. High heat will not affect the hardening alloy except to increase its hardness slightly, nor will it weaken the bond.

Preheating is most desirable or necessary if large parts are to be hardened or if the parts are of carbon or alloy steels having over 0.50% carbon.

Before applying hardening materials it is important that the surface be cleaned of scale, rust or foreign substances. This calls for grinding, machining or chipping. If none of these precautions is possible, sandblasting, filing or working over with a wire brush will help as a field expedient, although these steps do not get all the foreign material.

All corners or edges should be well rounded to prevent overheating of the base metal.

Electric Arc vs. Oxyacetylene

Electric-arc application is advantageous for large areas of application over irregularly worn surfaces, or where a fine finish or precision dimensioning is not necessary. Electrodes for hard-facing by electric-arc welding have a flux coating and no additional flux is required.

Oxyacetylene application is used where metal must be spread thinly. It is especially suitable for precision motor parts because of the closer control over the molten material. Generally this method requires no fluxes, although a flux helps to remove oxide and scale from the base metal when hard-facing in more than one layer. (A welding flux is specially needed in hard-facing cast iron, a cast-iron flux being satisfactory. The

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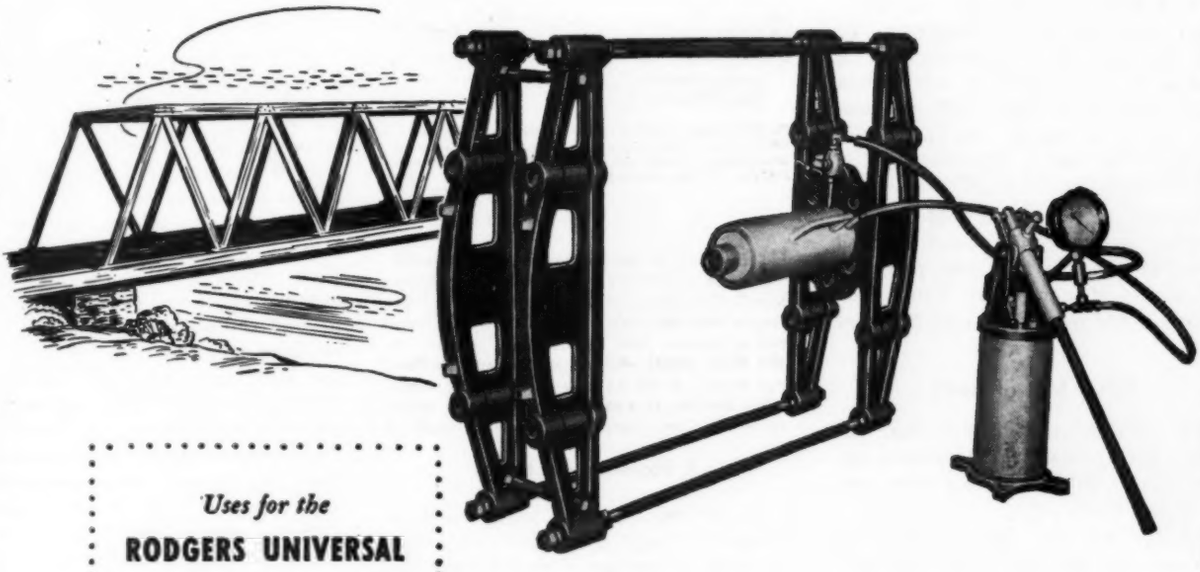
. . . states the superintendent of a construction firm.



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flux forms a thin film on the molten metal, slowing the cooling and allowing gas, oxides and slag to come to the surface.)

The carbon-arc process is usable on metals which can be hard-faced by either electric arc or oxyacetylene. The machine is set for straight polarity, the heat of the arc being used in this process, which is used principally in applying granular or powdered materials.

How to Tell a Good Job

The proof of a good hard-facing job lies in the extra service life it gives to the part treated. On a properly hard-faced part, the metal resists abrasion at red heat and withstands impact without shattering. To test for abrasion resistance, lay a bead or pad on a piece of low-carbon steel about ¼-in. thick, heat red and test on a grinding wheel. If it mushes off or wears away too rapidly, then it isn't "up to snuff".

For impact test, lay a cold piece on a solid surface and pound with a heavy sledge. If OK, the pad will not flake off nor break bond even when mashed nearly through the base plate.

What Size of Rod?

The thicker the hard-facing, the longer the service. Hence a ¼-in. application is longer lasting than one of ⅛-in. thickness.

Always use the largest rod size suitable for the job, since the per-pound cost of rod diminishes as rod diameter goes up. Size selection is determined by the thickness of the base metal and thickness of application desired. Do not try to apply a ¼-in. electric rod on a section less than ½-in. thick, for the heat needed for this size rod will cause excessive warpage and penetration. One manufacturer recommends 5/32 or 3/16-in. rod on sections ¼ to ½-in. thick, and 5/32-in. on metal under ¼-in. However, ⅛ or 5/32-in. rod can be used on very thick sections. A small rod is best for very thin deposits or narrow beads.

On very small areas or light metals, use smaller rod, to compensate for reduction in machine setting necessary to prevent undue dilution and burning through the lighter metal.

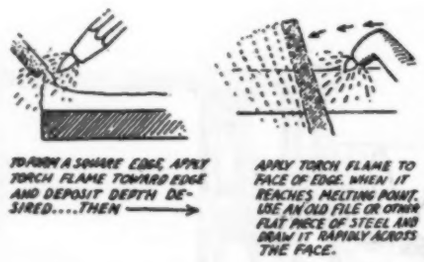


Fig. 5. How to hold a square edge in building up a flat plate is a common problem. Mir-O-Col Alloy Co.'s "Weldors Guide" instructs that the welder place a sheet of copper or carbon next to the plate to dam up the fluid metal while it settles and flattens out level. A file can be used on the metal after heating to near melting point, in order to reduce any sharp raised corner resulting

A Holding Jig Helps

If several identical parts must be treated it pays to devise some kind of a jig or mechanical device for holding and uniformly turning the part during application. The principal points to keep in mind here, as with all hard-facing, are that molten metal is best applied to a horizontal surface, and the operation should be continuous to prevent upsetting. The device must revolve the object at a uniformly slow rate under the flame if circular, as with an engine valve, or move the object or the flame in a steady straight path for treating a flat surface, as with a blade.*

Hard-Facing by Acetylene Procedure

Hard-facing by acetylene welding calls for preheating, preferably in a furnace, although a blow torch (acetylene or other type) may be used. Preheating helps insure against failures and gets the best job. Often preheating will have to be done in connection with jig operation. A typical example is that sketched in Fig. 1.

Applying the Beads

Fig. 2 shows the approved method of application on a shaft. The torch is held at right angle with the shaft. Flame has a 1-in.-long "brush". Cone of flame is not allowed to touch the surface being treated. Observing these general rules the welder (1) lays a single bead one-fourth the way around the shaft; (2) returns to the starting point and lays a bead along the shaft for about 3 in. holding the torch at an angle which covers greatest area with flame; (3) works back and forth filling in a quarter-round; then (4) repeats these operations on the opposite side of the shaft, to equalize stress; (5) fills in the remaining sections; and then (6) buries the shaft in lime or sand for slow cooling.

*See ROADS AND STREETS, May, 1944, page 95, for descriptions of successful valve hardening jig. Further details on jig practice will be presented in future articles.—ED.

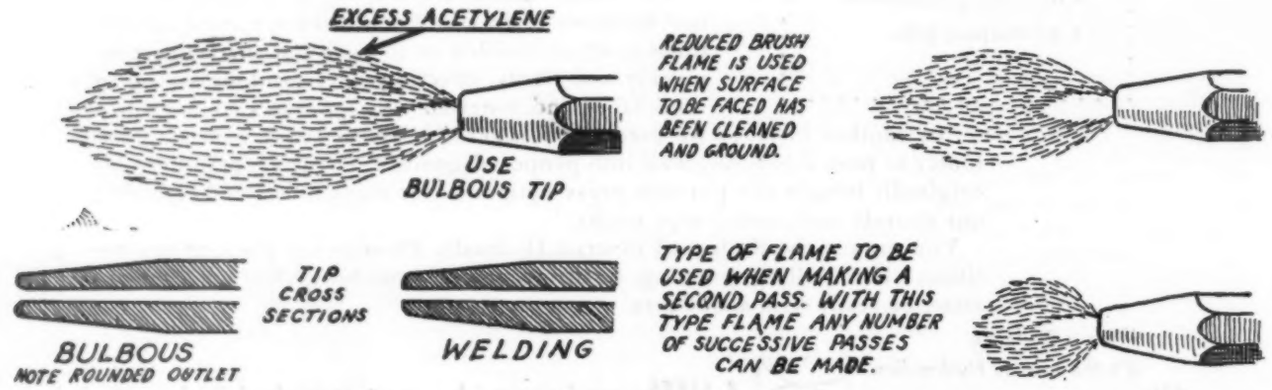


Fig. 3. (Left): on metal that has not been cleaned and ground, the type flame shown here should be used. The acetylene flame should be about six times the length of the cone. This type flame will reduce the oxides present in the form of rust and mill scale, leaving a clear surface

Fig. 4. (Upper right): A surface that has been cleaned and ground will have fewer oxides to be reduced than a dirty surface. Thus, the acetylene brush, which is the oxide reducing agent, should be cut down as shown here. (Lower right): To make additional passes over a layer of hard-facing, the acetylene brush should be reduced until it is only about twice the length of the cone. Very few oxides are present in the surface of deposited hard-facing and too much acetylene brush would deposit an excess of carbon, making the deposit brittle and forming a carbon scum on top of the fluid metal

The Tip and the Flame

Having the flame just right is the secret of acetylene hard-facing. The flame should be *bulbous*, and this calls for a tip of *rounded* construction (See Fig. 3).

To secure a soft, bulbous flame, the gages on both oxygen and acetylene tanks should be set at about 10 lb. pressure. The accompanying illustrations show the relative amounts of acetylene to use under given conditions. The shallow puddle will be clear of oxides and the deposited metal clear at all times if the regulation of acetylene is proper and the flame is kept soft.

Using a soft flame is equally important because in applying hard facing the melting of the parent metal *must* be confined to a very shallow depth. A harsh flame would penetrate too deeply and result in excess dilution of the hard facing. Very little penetration is necessary to assure a solid bond.

The Electric Process

Familiarity with the acetylene process helps the operator in successfully applying with the electric arc, since the processes are similar. The electrode is held to 45° angle, and using a long arc gives the characteristics of an acetylene "brush".

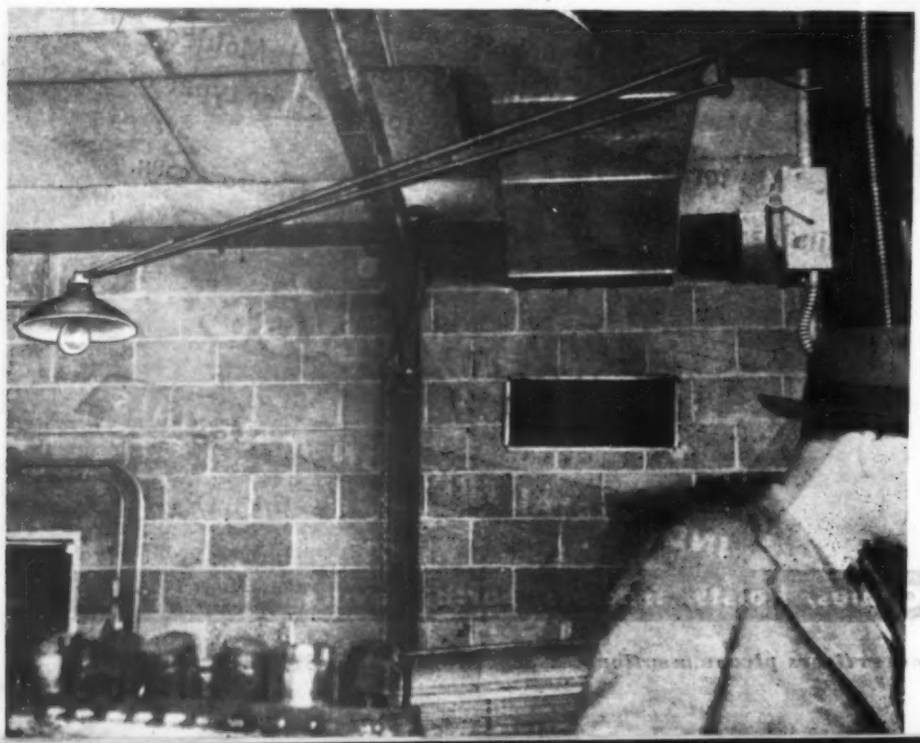
In fact, the action of the torch should be simulated as closely as possible electrically, in order to preheat the metal slowly ahead of the depositing and keep the hard-facing material fluid while impurities come to the surface. A high machine setting and long arc should be used.

In order to maintain a large molten area ahead of deposit and keep the deposit molten, a back-and-forth motion (1-in. forward, ¾-in. back) is used for a narrow bead and a circular motion for a wide bead. For a bead ½ in. or more in width, follow a spiral motion progressing ¼ in. each time around. These motions serve to delay cooling and hardening while impurities and gases are released. The speed of deposition controls its thickness.

The 45° angle of the rod directs the "blow" from the arc although the arc itself will jump straight down. The long arc is necessary since a short arc will confine the heat to a small area with excessive penetration and "upsetting". Only a slight penetration is desirable or necessary to create a bond, and hard-facing so placed will be hardest because of least dilution.

To deposit a single narrow bead on an edge, set the welding machine high enough to heat the rod a dull red full length during application.

Use the longest feasible arc that won't make the rod coating pop off in chunks. In putting down more than one layer, be sure the first layer is still red when applying the second, and so on. It insures proper bond.



Aviation Engineers Observe Fifth Anniversary

THIS month one of the U. S. Army's most gallant and hard-hitting units is observing its fifth anniversary—the Aviation Engineers of the Army Air Forces.

Organized in 1940 as an integral part of the Air Forces and dedicated to the job of bringing the strength of our air arm ever closer to the enemy's vitals, the Aviation Engineers have truly "teethed on the difficult" and now again and again do the impossible. No lengthy discourse on the feats they have performed could do justice to the quiet way they have gone about their task of speedily building airports to bring the point of our air power within sword's length of the enemy, airports which were required to be built almost always at the front lines and in some cases—such as Burma—behind the enemy's lines, airports which often were built by Aviation Engineers who one moment were operating their construction equipment and the next were beating off enemy attacks threatening their work.

To these Aviation Engineers, who fought their way through Africa, Italy, France and islands of the Pacific—to these men who have known this war from the first roar of bombs at Pearl Harbor and the Death March at Bataan—"Roads and Streets" extends its congratulations and offers its best wishes for continued successes in future operations.—The Editor.

▼

New York—A new bridge across Irondequoit Bay near Rochester, to cost $1,500,000, is included in the state's huge postwar public works program, for which Gov. Dewey recently signed "go ahead" legislation.

▼

Swivel Arm for Shop Light

The average shop never is lighted quite well enough, and carrying a light around on a wire cage on the end of a rubber covered cord doesn't always do the whole trick.

In equipping their new shop quarters at an old roadside garage building near Rochester, Minnesota, the shop men of the contracting firm of Quarve-Anderson built the swivel arm shown in the accompanying photograph. Not novel—just a conventional design made of scrap parts and bolted to a column. Having an arc of 8 ft. this device enables the men to move a 200-watt lamp and reflector back and forth between either of two repair bays, and to adjust the position of the light for best work.

Surgeons and prize-fighters work under a battery of overhead lamps. At least one good lamp up there will help the mechanic too.

How many dollars is a good truck worth?...

When Lincoln was asked how long a man's legs should be, he answered, "Long enough to reach the ground."

The same homespun reasoning applies to the worth of a motor truck. The work you get out of it is what counts.

That is why Mack trucks are bargains—*on the job!* Mack trucks are *built* to work harder, to last longer and to operate at lower ton-mile cost.

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Mack's better construction has been making money for Mack owners since 1900. Now is the time to find out what it can do for you.

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*

What Load Limits for Contractors' Heavy Equipment?

*

We'll have to tighten up on overload permits or ruin a lot of our roads, is viewpoint of Minnesota department of highways. Contractors and equipment men faced with compliance problems.

STEPS taken in Minnesota have thrown the spotlight on the serious problem of transporting heavy road building and material production equipment over the highways. In this state, as elsewhere, higher emergency wartime limits have been in effect, and a great volume of special permits have been issued. Enforcement has inevitably relaxed under pressure of war production hauling. The state's roads, as a consequence, have shown considerable damage, the damage being particularly noticeable during the spring breakup season. One bituminous surfaced state-aid road observed by the "Roads and Streets" editor, for example, was literally ruined in a few weeks of spring weather by overloaded milk tank trucks hauling in to dairies at Rochester, Minn.

Three Recent Steps

Three steps, as outlined by O. L. Kipp, Chief Engineer, Minnesota State Department of Highways, were taken recently, as follows:

1. Gross load limits and limits on closely spaced axles were revised slightly downward by a new state law signed in March. The old maximum of 30,000 lb. for tandem axles spaced less than 10 ft. apart was abolished. The new law provides that for axles spaced less than 18 ft. apart, the gross load shall be determined by multiplying the axle distance plus 40 by 650. Thus two axles spaced four feet apart would mean multiplying 44 by 650, making the maximum load 28,600 lb., or 14,300 lb. for each axle. For axles spaced 18 ft. or more apart, the gross load is determined by multiplying 750 by 40 plus the distance between the first and last axles. Thus for a group of axles, 30 ft. between the first and last axles, the formula would be 40 plus 30 multiplied by 750, making the maximum load 52,500 lb. The old maximum of 18,000 lb. for any single axle is retained and applies in all cases.

2. No special permits for loads exceeding legal axle load limits were issued during the 1945 spring thaw season. Strong effort was made to rigidly enforce these limits, as well as spring load restrictions on nearly 6,000 miles of state trunk highways.

3. Enforcement of legal limits, relaxed somewhat during the war, have been tightened up and special permits issued less freely. Plans are being made for inventorying and registering the gross weight of all overweight equipment and heavy trailer units, so that the combined weight of any proposed shipment can be checked definitely in advance of issuing any special permit. This will allow more expeditious handling of permits, which have totaled up to 10,000 annually.

Problems Aired in Meetings

Highway industry representatives in the state held two meetings this spring to air this question. The seriousness of the load problem was shown by the fact that owners, distributors and even representatives of manufacturers of certain crushing plant and other equipment, who were present, did not know within several thousands of pounds just what their units actually weighed on the flatbeds.

Loadometer checks have revealed tremendous overloads, it is claimed. One make of a heavy-type crushing plant moving on its own rubber was said to weigh 68,000 lb. on tandem axles, or 32,000 lb. per axle (4,000 lb. over special leeway). Power shovels on trailers constitute a more frequent source of overload. As a result of the new enforcement numerous contractors have had to divide heavier units into sub-assemblies, replace single axles with tandems, and make other expensive changes for highway shipment.

* *

What does she weigh on the hoof? Minnesota state highway load inspector in above seen checking up on the empty weight of a machinery trailer, at shop of Quarve & Anderson, road surfacing contractors of Rochester, Minn.

The state highway department is trying various means of making equipment owners more weight-conscious. It has considered a policy on contractor's equipment of allowing 10% margin over the legal axle load limit for tandem axles, and of allowing 20,000 lb. instead of 18,000 lb. for single axles if spaced 12 ft. or more apart. Meanwhile it has been decided that all present equipment can be moved as it has been moving with special permits where requested until further notice. Special notice on load limits applying to specific work henceforth may be given in advertisements for bids, or specific load limits stated in special contract provisions.

Arguments in Support of Higher Limits

Many interesting facts or claims on both sides of the case came out in the industry meetings. A bulletin from R. J. Hendershott, Manager, Associated General Contractors of Minnesota, lists the following considerations, as set forth by a special committee.

1. Contractors' equipment moves at extremely slow speed with negligible damage to the highways and bridges, as compared with loads up to legal limits moving at speeds of 35, 45, and 50 mph.

2. The movement of contractors' equipment constitutes only 2 to 5% of the total business of heavy haulers, which in proportion to the total overweight loads moved over Minnesota highways and bridges is even smaller than 2 to 5%.

3. If heavy haulers are restricted

to a smaller pay load, higher tariffs will be the inevitable result. Since tariffs are now based on a minimum of 20,000 pounds, the hauling of a bulldozer attachment, for example, would mean payment for load not moved unless other items could be included.

4. Regular haulers such as tank haulers, pulpwood haulers, coal haulers, etc., can arrange to move lighter loads as a regular thing, but contractors' equipment does not permit such flexibility.

5. The load limitation with the type of equipment now in use and adjusted to provide two tandem axles for trailers, would still be over the maximum weight allowable under the suggestions made by the department for such items as D-8 tractors, shovels over one-half cubic yards, 27-E pavers, etc.

Low Pay Load

6. For the tandem axle trailer discussed, the gross load permissible of 62,000 pounds, becomes 33,000 pounds in terms of pay load.

7. Minnesota weight requirements will have to fit into standard lines as produced by various equipment manufacturers, as the Minnesota market is too small in proportion to the total market to warrant any special designed equipment.

8. Even equipment manufacturers in Minnesota report that their Minnesota sales are an extremely minor percentage of their total sales, and they also would not find it economical to develop any special designed equipment to meet Minnesota weight requirements.

9. The immediate postwar demand for equipment is such that it is anticipated that manufacturers will continue to produce the various units as they are presently being produced, and it will probably be several years before the supply will catch up with the demand sufficiently to permit manufacturers to make important changes in design in order to meet any such Minnesota weight requirements.

10. Equipment distributors of certain standard lines of the heavier contractors' equipment may find their markets cancelled out over-night if the department's position is not changed, and if manufacturers are unable economically to produce units meeting the Minnesota weight requirements.

11. Bridge loads for a number of years have been based on 3,000 lb. concrete, but the general result is, as shown by tests, that 5 and 6,000 lb. concrete is obtained; it would seem conservative, therefore, to figure the average strength at 4,500 lb., which would allow a 50% increase in bridge loads.

In 12 years a study has shown that the proportion of highways adequately improved dropped from 75% to 54%. Equipment representatives present pointed out that with the exception of Minnesota and Iowa, no difficulty was experienced in the movement of their equipment over the highways, that such restrictions on the part of the Minnesota department would make such equipment noncompetitive and would almost certainly have the effect of increasing the cost of construction.

Big Loads Relatively Few

Mr. Kipp, State Department of Highways, pointed out several facts:

Twenty-eight per cent of the bridges require limits proposed, and the cost of replacing of such bridges is estimated at $14 million—most of them having been built before 1925. Federal-aid regulations would probably prohibit an allowance of that much Federal aid to a bridge program.

In 1941, the Minnesota department had almost the lowest construction costs in history on most types of work, and were well aware of the contribution made by mechanized operations.

The highway plan survey figures show that even under spring break-up load restrictions that 96% of the truck traffic can move over the highways in 4-ton jobs or less, and for loads of 7 tons or less, about 99% of the truck traffic can move. In other words, about 75% of the 125 thousand trucks in use, do not constitute a weight problem. At the same time, truck traffic as a whole, is only 10% of the total traffic on the highways. Therefore, it is clear what user groups must be given the most consideration in maintaining the system.

Thus this question clearly has two sides, and the highway industry nationally will watch the Minnesota picture for its effect on bid prices and on equipment designs.

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(*Continued from page* 70)

without WPB authorization and expansion of other exemptions from the provisions of the order. These exemptions permit certain types of construction jobs without WPB authorization or regard to annual cost limits. Chief among these exemptions is preliminary earth-moving operations if no lumber or other construction materials except drainage pipe are required.

Most important change other than that of easing grading and ditch digging, etc., is that the cost limit on a bridge, over or under-pass, tunnel, dock or pier has been raised to $25,000 (formerly $1,000). The grading exemption will permit initiation of work on highway airports and other types of construction. The WPB pointed out that this does not necessarily mean that they will approve construction in the future or grant priorities assistance, even if the applicant has done a large amount of preliminary work under the exemption.

John L. Haynes, director of WPB's Construction Bureau, in a statement explaining the impossibility of lifting controls on construction completely at this time said that the construction industry is one of the largest potential users of resources and one of the largest potential employers of manpower making it a key industry in the partial reconversion made possible by V-E Day. He stated that it should operate under as much freedom as possible but inasmuch as lumber and many other construction materials are expected to remain in short supply for some time, and manpower is not yet available in many areas, these factors, together with the necessity of maintaining war production, make it impossible to remove all construction controls now. However, he said, "controls will be relaxed just as soon as resources become available, but relaxation will have to be gradual."

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Louisville Has 32 Truck Terminals

The importance of commercial truck traffic as a consideration in metropolitan street and highway planning, is shown by a report of the Louisville (Ky.) Area Development Assn. The Louisville area has 32 individual truck terminals, large and small. A union terminal that may save thousands of truck-miles daily is proposed and a committee of the Assn. is studying the problem as part of the greater problem of postwar street planning.

▼

Washington—A new Manette bridge across the narrows at Port Washington to Bremerton, Washington, is being planned, an application to FWA for funds having been made recently. The cost is estimated at $2,440,000, of which the state and city of Bremerton would each pay roughly one-third.

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In all parts of the world you'll find them serving today . . . the thousands of road builders who've gone out from contracting firms, state highway departments, and county, city and federal engineering posts. Here is news of a few of them. Send us items!

Mississippi's Former Chief

Picture here on a South Pacific Island: **Comdr. R. A. Harris**, CEC, USNR, right, and **1st Lt. Laird**, Marine Corps. Commander Harris was previous to March, 1943, Chief Engineer of the Mississippi highway department. Since June, 1943, he has been Public Works Officer in charge of all Seabees construction at the Naval Advanced Base where above picture was made. Lt. Laird, called "The Arkansas Traveler," was formerly in the contracting business at Jonesboro, Ark. Photo supplied by Mississippi's Acting Chief Engr., J. D. Monette.

Comdr. R. A. Harris and 1st Lt. Laird

Vermont Road Men

Vermont Commissioner of Highways, H. E. Sargent, reports with justifiable pride that 45 former employees of the state's relatively small staff are in the armed forces, 28 of which hold commissions or warrants. These include: **Lt. Comdr. Willard Day**, former bridge designer, who was with the Seabees in the Pacific; **Maj. Wm. Stebbins**, former employee, with Gen. MacArthur's staff and who wears the Bronze Star; **Lt. Steven Dunn**, with an Engineer unit in Africa and Italy; **Capt. Philip Thomas**, with the Signal Corps in Iran; **S/Sgt. Louis Lovin**, with Infantry in Europe; **S/Sgt. Lee Cowles**, with Air Corps in Hawaii; **W/O John Durkee**, Artillery, who was in Philippines invasion.

Three men are honorably discharged and back with the department. One, Corp. Dean Wells, with the Tank Corps, died in Belgium.

Michigan Hy. Dept.

Comdr. Dan Henry, formerly a Dist. Forester, and a World War I veteran, has been in service since Pearl Harbor. His staff at USN Recruiting Station, Dallas 1, Texas, recently won a trophy for setting a record.

Comdr. Dan Henry

Col. M. H. Thompson, formerly Estimating Engineer with the Mich. department, received his present promotion after duty as a Capt. in coast artillery in American posts, two years in England on amphibious observation and administrative work with the Pacific fleet. Address: 0-249377, Staff Comdr. Ad. Comd. Phib. Fors., Pac. Flt., FPO, San Francisco, Calif.

Col. M. H. Thompson

Lt. Col. Wm. H. Harvie, former Road Engineer, was appointed Director, Alaska Highway Construction and Maintenance Div., last summer, with **Capt. Floyd Stevens**, former Supt. of Kent County, Mich., Maint. Div. as his assistant. His mission was to establish uniform camps, preliminary to setting up Canadian maintenance personnel, and he has had the hardy experience of fighting snow, frozen rivers and other winter difficulties up North.

Lt. Col. Wm. H. Harvie

Oregon Men in Uniform

Reports Oregon state highway Engineer R. H. Baldock: **Merle Stephenson**, former Asst. Bridge Engr. with the highway commission, is assigned with the Military Geology Unit, in Pacific Area; **Capt. John Beakey**, former Traffic Engineer, is in a hospital at Spokane, Washington, convalescing from injuries received in Normandy while in the Transport Corps.; **C. A. Gardner** has returned to his former engineering position with the Commission at Salem, after having served in the South Pacific as a Marine Captain; **Capt. L. W. Franklin**, formerly a resident engineer, after 2½ years in England, Africa, and Italy, recently returned home to Salem on furlough. His first experience under fire was at the initial landing at Oran; his Engineering company went in shortly after first shock troops.

Montana Men in Service

Lt. Col. Scott P. Hart, U. S. Army, now stationed at Fort Douglas, Utah; formerly maintenance engr.

Maj. W. E. Bawden, U. S. Army Ft. Baker, Calif.; formerly equipment engr.

Lt. Myron C. Lockey, formerly district engr., now with Seabees in the South Pacific.

Connecticut Road Builders

Among the 491 members of the Conn. state highway department, who have entered the armed forces are: **Robert S. Chidsey**, sr. highway boundary engr., now a Lt. U.S.N.R., C. B.; **Paul E. Flux**, asst. highway engr. (drainage), now Capt. U.S.N.; **Howard S. Ives**, asst. highway engr. (bridges), now Lt. Col. Army Engrs.; **A. Louis Kalas**, maintenance district supervisor, Capt., now Army Engrs.; Ernest T. Perkins, asst. hwy. engr., Capt., now Army Transportation Corps; **Bernard J. Freedman**, asst. hwy. engr. (bridges), Capt., Artillery; **Wendell L. Holsten**, asst. hwy. boundary engr., Maj. Army Air Forces.

Capt. C. S. Slack, is the new way to address this former member of the Syracuse, N. Y., city engineering staff. According to City Engineer N. F. Pitts, his APO is now No. 562.

3 to 4 ft. of the lower limit of the frost zone, or the top of the subgrade if no frost, the seepage should be intercepted. The effective capillary rise (sufficient volume of water raised to do damage) will be less in soils of high clay content and more for those high in silts. Pure silt soils have an effective capillary rise of 8 ft. or more.

Water bearing strata (seepage zones) often have steep and irregular dip and direction. In other words, its profile along the line of the proposed drain may be very irregular fn elevation. Such conditions often require changes in depth and grade from those shown on the plans. It is, therefore, evident that such work requires close, competent supervision if satisfactory results are to be obtained.

Separate and Combined Drains

In the New England States and in others having similar climate and seepage conditions, dangerous ice conditions occur from bank seepage or from melting snow pushed off the pavement. Catch-basins and storm drains are often necessary and in many cases an intercepting subdrain is also necessary. A properly designed pipe will satisfactorily perform both functions. It should have an unperforated invert to carry the normal seepage flow.

The use of such drains in Connecticut is reducing the cost of removing ice as shown in Fig. 7. Savings in maintenance pay for the drain within an average of 4.5 years.

Base Drainage

The use of pervious bases is rapidly increasing. Some states have been using them for years while others are just beginning. Probably 75% or more of the pavement failures in the prairie states where clay subgrades prevail are caused by roof leakage. Mud pumping is so common that mud jacking equipment is on the market. Sizable contracts are being let for patching of concrete pavements which have failed beyond the stage of mud jacking repair. The answer is "lack of drainage."

Bituminous pavements also suffer from roof leakage. A very common failure occurs when bituminous surfaces are placed on old clay-gravel surfaces used as bases. Water passes into and through the bituminous surface, wets the clay, causing a loss of bond and raveling. Freezing of the trapped water also no doubt contributes to the damage. The same experience has been had with gravel bases containing too much clay. Many pavements of all types, even though

(Left): Storm drain and sub-drain in same trench. Seepage was from the right and their positions should have been reversed. A combined drain would have been satisfactory. (Right): 12 in. of crushed stone was placed under this intercepting sub-drain. This is very bad practice because it creates a sub-drain under the drain pipe with a continuous wet condition

laid on pervious bases, have failed because no outlet was provided for the roof leakage.

Well-drained pervious bases are needed where the subgrades are impervious. The method of draining is suggested in Fig. 8. Modified methods may be used, depending on the conditions, but usually the small net saving is not justified when compared to the possible damage. French drain outlets have been used to drain pervious bases but, due to silting, most of them have become ineffective within two years. The extension of pervious bases to the shoulder slope is a method which has been used extensively but to be effective in allowing water to pass through, coarse material is necessary. Our present knowledge of filter material requirements should increase the doubt of the ad-

visability of using such drainage methods.

Transverse base drains, in conjunction with longitudinal base drains, are needed where the longitudinal slope of the base is greater than its transverse slope. Their spacing is a matter of judgment. They should at least be used at the foot of all slopes and at the section of zero cut and fill. Fig. 9 shows an alternate design using crushed stone. Being protected on top by the pavement, these "French" drains will be satisfactory provided the soils are non-silting and the runs are not too long.

Summary

Like other branches of engineering, subdrainage is largely common sense. Hydraulics and soil mechanics are involved, but not to the extent represented by some technicians. The most difficult part of the problem is the determination of under surface conditions, especially the location of free ground water. A knowledge of geology will greatly assist in the problem and some states employ a geologist to assist the soils department. After knowing the conditions, the drain can be designed as to the best location, the proper depth, the proper trench bottom, etc., to prevent damaging water from reaching the subgrade.

The recent development on proper backfill is the outstanding forward step taken in subdrain construction in many years. It insures continued service of the drain providing the infiltration area in the pipe is properly designed. Good subdrainage is the best and cheapest insurance for highways.

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Penn. Scenic Parkway Proposal

Appointment in Pennsylvania of a commission to proceed with plans for construction of the Pocono Scenic Memorial Rim Parkway as a postwar project has been recommended by the Pennsylvania Postwar Planning Commission. Construction will cost between $6,000,000 and $10,000,000; road to be financed by private funds as a toll project.

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System Mileage Changes in Washington

Under a state highway "omnibus" bill recently enacted, 75 miles of highways were withdrawn from the state primary system and 300 miles added to the State secondary system. Individual counties lost or gained as much as 31 and 29 miles respectively of primary and 44 and 83 miles of secondary road designation in this effort to adjust the system.

1944 Motor Vehicle Registrations Show 1.4% Decrease

Automobile registrations in 1944 reflected the downward trend that has prevailed for the past few years, but motor truck registration showed a slight increase over 1943, according to figures compiled by the Public Roads Administration from reports of state authorities.

A total of 25,466,331 privately owned automobiles were registered in 1944, as compared with 25,912,730 registrations in 1943, a decrease of 446,339 or less than 2 per cent. The decline from the all-time high of 29,524,101 passenger cars registered in 1941 was 4,057,770, or nearly 14 per cent.

Truck registrations last year totaled 4,513,340, against 4,480,176 registrations in 1943, an increase of 33,164 or almost one per cent.

Motor vehicle registrations reported during the first quarter of 1945 indicate that further decrease this year in the registration of privately owned vehicles, as compared with registration figures for 1944, will not be great.

The total number of private and commercial vehicles registered in 1944 was 30,086,189, a decrease of 413,419 or 1.4 per cent as compared with 1943 registrations.

New Equipment and Materials

New Hydro Steer for Construction Equipment

A postwar product to be offered to heavy wheel equipment manufacturers soon is the new Heil Hydro Steer, a constant ratio hydraulic steering mechanism developed by The Heil Co., Milwaukee, Wis. The Heil Hydro Steer was designed by Henry French, Heil engineer in charge of development, and has been used extensively on some of the heavy, motorized war equipment built by the company. The Hydro Steer has no mechanical connections between the steering wheel and the axles. Impetus is transmitted through flexible ducts or hoses much the same as on conventional passenger cars. The steering head, to which the steering wheel is attached, contains a steering drive, metering pump,

The steering wheel controls hydraulic pressure upon individual wheel cylinders in the new Heil Hydro Steer unit

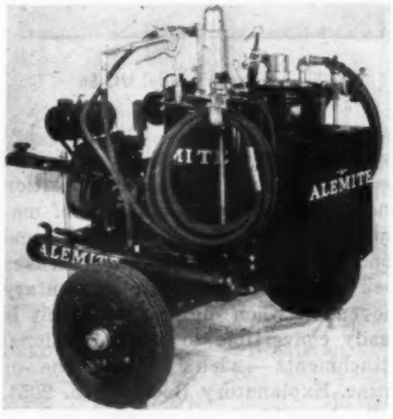
steering valve, relief valve, check valve and oil reservoir. From the oil reservoir in the steering head, the oil is drawn through a suction line to an engine driven hydraulic pump. The steering wheel serves merely as the hydraulic control-valve lever for the power steer. When the steering wheel is turned to the right, the pump forces oil into the left-hand cylinder causing right-hand steering movement. For a left-hand turn the pressure is on the right-hand cylinder. Front wheels of the vehicle will remain in a locked position until the steering wheel is turned to allow a flow of oil in either direction. The metering pump gives a constant ratio between steering wheel movement and vehicle front wheel movement. Should the power driven pump ever fail, the metering

pump automatically becomes the power pump, and draws oil through the check valve from the oil reservoir and forces it into the steering cylinders by manual effort of the steering wheel only. This gives the added safety of a standard mechanical steering gear. Practical applications of the Heil Hydro Steer include its use on earth-moving wagons, scrapers, graders and other construction equipment, as well as on rear-steer units, such as fire engine ladder trucks, and on boats.

▼

New Portable Lubrication Unit

A small "portable service station" for supplying high pressure lubrication for construction equipment, trucks or cars and farm machinery, has been announced by the Alemite Division of Stewart-Warner Corporation, Chicago, Ill. The unit also can inflate tires on all pneumatic-tired vehicles or equipment; dispense gear lubricant or motor oil, and apply rust preventive or other surfacing material to equipment or other surfaces. This unit, supplying both high and low pressure lubrication, has its own air compressor, driven by a gasoline motor. The tubular base on which the entire unit is mounted serves as an air tank or reservoir. The entire unit weighs but 246 lb. and measures 29½x31⅛ in.



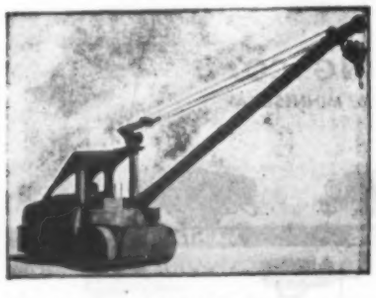
Portable Lubrication Unit

▼

New Cargocrane

A new model has been added to the Link-Belt Speeder line of general purpose cargocranes. This new Model YC-5 is a one man operated machine. It has a lifting capacity of 2900 lb. at 15 ft. radius, up to 15,000 lb. at 3½ ft. radius. The boom swings in a full 210 degrees; with short turning radius of chassis. Wheel base is 10 ft. 9 in. Full hydraulic operation of swing

mechanism and steering plus position of operator which gives clear view of work from all angles, makes this machine extremely easy to handle. Steering is accomplished by dual-wheels operating on a pivoted axle. The entire unit is operated by a 3-speed transmission from a 57 H.P. gas engine, for traveling, swinging, hoisting and boom hoist. There are three traveling speeds forward and one reverse, with a low speed of 1.9 M.P.H. and a high speed of 6.75 M.P.H. Boom is of a goose-neck type, 20 ft. long and can be furnished either in one piece or telescopic. Explanatory Booklet No. 2071, fully describing this machine, may be had by writing direct to Link-Belt Speeder Corporation, 309 N. Michigan Ave., Chicago, Ill.



New model YC-5 Cargocrane

New Shovel-Crane

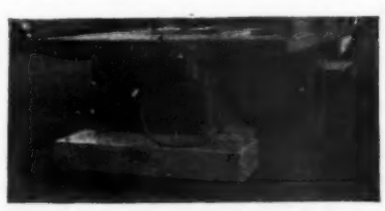
A new wheel-mounted shovel-crane has been added to the line of the Link-Belt Speeder Corporation. This is a ½ yd. machine with a lifting capacity of 6 tons. Overall width is 8 ft., wheel base 7 ft. 6 in. and overall weight equipped as a shovel 26,350 lb. The machine is mounted on dual wheels, with 10x20-12 ply pneumatic tires, and can be driven over highway at speeds up to 10 miles per hour. Easy steering is accomplished from the operator's position in the crane cab by hydraulic power. Other important features of this unit are automatic hydraulic stabilizers which lock the oscillating front axle in any position and greatly increase stability of machine; equalizing for uneven ground conditions. Power hydraulic brakes lock machine against involuntary movement when digging. The unit is easily convertible to all conventional attachments — shovel, dragline or crane. Explanatory Booklet No. 2051, fully describing this machine, may be had by writing direct to Link-Belt Speeder Corporation, 307 N. Michigan Ave., Chicago, Ill.

Shovel-Crane Model UC-56

▼

New Road Sweeping Magnet

A new rectangular suspension, high intensity, electro-magnet is now available for sweeping roads clear of tramp iron. The unit is a double gap model with the gaps constant at all points to promote even distribution of magnetic flux over the entire magnet face, according to the manufacturer.



Road Sweeping Magnet

It is claimed that the equal pull thus exerted enables the magnet to remove tramp iron from all of the road area covered. The new model road sweeping magnet operates from a generator set carried on the truck bed and comes in a complete range of sizes to meet any requirements. Complete units including magnet, generator, and trailer are available. Additional data may be had from the Dings Magnetic Separator Co., 509 E. Smith St., Milwaukee 7, Wis.

Obituaries

WINFIELD HOPKINS, 55, county engineer of Morris County, New Jersey, since 1918, died June 1 at his home in Kenoil, N. J., from a heart attack. He was appointed assistant county engineer in 1916, became county engineer two years later.

▼

CHARLES D. KESLER, 44, engineer plans and surveys, Oklahoma State Highway Department, died recently. He had been with the department for 21 years.

▼

HOLTON D. ROBINSON, 82, senior partner in Robinson & Steinman, consulting engineers, 117 Liberty St., New York, died last month. He had played an important part in the design and construction of some of the world's largest bridges, including the George Washington and Triborough bridges in New York and the Thousand Islands bridge over the St. Lawrence River.

▼

HOWARD G. HUNTLEY, member Piazza & Huntley, contractors, San Jose, Calif., died May 12 in Woodside, Calif.

▼

ROBERT M. COMSTOCK, 76, an engineer for 46 years in the city engineer's office in Minneapolis, Minn., died last month. He retired in 1931.

▼

WILLIAM J. HENDERSON, 45, associate professor of structural engineering at Purdue University, died suddenly May 10.

THOMAS H. JOYCE, 78, president Cameron, Joyce & Co., highway contractors, Keokuk, Ia., died recently in that city. He entered the contracting business in 1893, becoming associated with Cameron, McManus & Joyce, which later became Cameron, Joyce & Co.

▼

GEORGE W. FORSYTH, 64, for 42 years an employe in the city engineer's office, Seattle, Wash., died in that city last month.

ROBERT C. POST, 66, president Post & McCord, Construction Engineers, 101 Park Ave., New York City, died last month in Englewood, N. J. From 1899 to 1903 he was connected with the American Bridge Co., leaving in the latter year to join the firm of Post & McCord.

▼

DANIEL J. LENCHAN, 49, resident engineer, Connecticut state highway department, died May 17 in Hartford, Conn.

With the Manufacturers and Distributors

C. M. Van Epps to Represent Goodyear in Australia

C. M. Van Epps, sales manager of the Arizona division of Goodyear Aircraft Corp. at Litchfield Park since June, 1944, has been appointed assistant sales manager of Goodyear-Australia. With the company since his graduation from Kenyon college in 1926, he has served in the sales organization of The Goodyear Tire & Rubber Company, in Baltimore and Philadelphia districts and in Akron on sales analysis work. He has been assistant store manager for the company at Philadelphia, St. Louis and Oklahoma City, and in 1941 was made district store supervisor at Kansas City.

▼

E. Franks to Handle Wheel Tractor Sales

Allis-Chalmers Manufacturing Co., Tractor Division, has announced the appointment of Ernest Franks in charge of sales of industrial wheel tractors and power units with headquarters at Milwaukee, Wis. Mr. Franks has been with the company since 1927. From that time until 1935, he was engaged in service and field engineering. His broad experience in the field qualifies him well to handle sales of industrial wheel tractors in addition to the power unit department, which he has headed for the past ten years.

E. Franks

▼

R. K. Evans New Secretary for Davey Compressor

Karl Cooke, secretary of Davey Compressor Co., Kent, O., for the past 15 years, has resigned his post in order to move with his wife to a climate which physicians believe will be more beneficial to her health. R. K. Evans, office manager for many years, suceeds Mr. Cooke as secretary and active head of the accounting department.

Osgood-General Excavator Advertising Manager Cited

Lt. Col. Myles (Ken) Stolz, formerly advertising and sales promotion manager for The Osgood Co. and The General Excavator Co., Marion, O., has been presented with the Bronze Star Medal for "meritorious services in connection with operations against the enemy." He received the medal at the 15th AAF headquarters in

Lt. Clo. Stolz being congratulated by Maj. Gen. Nathan F. Twining, Commanding General of the 15th Air Force in Italy

Italy where he is executive staff officer. Col. Stolz was associated with Osgood-General Excavator until he entered active duty with the CCC in 1933. He has been an officer in the infantry reserve since 1922. He served as a captain from 1933, until February, 1941, when he was promoted to major. In August, 1941, he entered the Air Corps, and was promoted to Lt. Colonel in February, 1942. He left for overseas from an air base in Salt Lake City, Utah, in April, 1943.

▼

Timken Elects Bergstrom Vice President

At a Board meeting held May 1, 1945, Albert L. Bergstrom was elected vice president of all engineering for Timken Roller Bearing Co., Canton, O. Mr. Bergstrom, born in Sweden, was graduated from Royal Technical Institute in Stockholm, Sweden, in Mechanical Engineering, came to this country in 1924, and became designing engineer for the Stearns Conveyor Co. of Cleveland, O. He remained with Stearns until 1929 when he came with the Timken Co. as development engineer. He was given various engineering and development assignments, later became chief works engineer, and in 1938 was made executive engineer. In his new duties as vice president of engineering, he will have complete charge of all engineering activities.

Changes in Caterpillar General Sales Department

Several changes in the general sales department of Caterpillar Tractor Co., Peoria, Ill., have been announced by H. H. Howard, general sales manager of the company. F. D. Haberkorn has been appointed assistant sales manager of the Central Sales Division; C. A. Barabe, Jr., has been named assistant sales manager of the Eastern

C. A. Barabe, Jr.

J. D. Haberkorn

Sales Division; and F. E. Rusher, assistant sales manager of Central Sales since 1937 has resigned to become general sales manager and a director of Peoria Tractor & Equipment Co., "Caterpillar" distributor in the Peoria area.

Mr. Haberkorn joined "Caterpillar" ten years ago as a member of the Sales Training division and has had eight years of field experience in several territories. Since September, 1944, he has been assistant sales manager of Eastern Sales. Mr. Barabe joined the Company in 1937 and traveled extensively as a special representative and earthmoving authority. Early in the war he entered the U. S. Army, serving in the North African, Sicilian and Italian campaigns. Returning to Peoria in 1944 as lieutenant colonel, retired, he resumed his work as consultant on earthmoving. Mr. Rusher has been a member of the "Caterpillar" organization since 1931. He served first as a district representative, then as agricultural sales supervisor, from 1935 to 1937 when he was promoted to assistant manager of Central Sales.

F. E. Rusher

New President for Prismo

Armand E. Keeley has been elected president of Prismo Safety Corporation, Huntingdon, Pa., manufacturers of reflective material for marking highways and airports. He assumed his new duties April 1.

New Davey Dealers

Recently appointed to provide additional Davey sales and service facilities in the Chicago area is Acme Contractors Machinery and Equipment Co., Inc., 4221 W. Harrison St., Chicago, Ill. The firm will handle the complete Davey line. Garson Iron and Steel Co. has been appointed to handle the complete Davey line of stationary and portable compressors, heavy-duty truck power take-offs and pneumatic saws in the area surrounding Duluth, Minn. The new dealer's main offices are located at 512 Lyceum Bldg., Duluth 2, Minn., and a branch is still maintained at Norfolk, Va., where the firm was founded in 1897 by the late H. J. Garson, father of the present head of the company.

▼

New Macwhyte District Sales Managers

R. P. Tyler, general sales manager of Macwhyte Co., Kenosha, Wis., has appointed Fred M. Sime as district sales manager for the Pacific Southwest and Wm. J. Brett, district sales manager for the Pacific Northwest. Mr. Sime is located at Macwhyte Co.'s San Francisco office, 749 Bryant St. Mr. Brett is located at the company's Portland (Ore.) office, 1603 N. W. 14th Ave.

▼

New General Superintendent for Buffalo Plant Wickwire Spencer

Alvin F. Franz has been appointed general superintendent of the Buffalo, N. Y. plant of Wickwire Spencer Steel Co. Mr. Franz was previously General Superintendent of the Allan Wood Steel Co., Philadelphia, Penn., a position he held for 15 years. Previously he was Open Hearth Superintendent of the Otis Steel Co., Cleveland, O. In his new position, he will be in charge of all production at Buffalo, including Wickwire Spencer's Open Hearth, Hot Mill and Wire Departments.

▼

New Blaw-Knox Distributors

Two new distributors have been announced by Blaw-Knox Co., Pittsburgh, Pa. The C. H. Jones Equipment Co., 236 W. South Temple St., Salt Lake City, Utah, will serve as distributors for road products and buckets. The Acme Wire & Iron Works, 1343 W. Laurel St., San Antonio, Tex., will be road products and buckets distributors in the San Antonio territory.

New Chief Engineer at Novo

Robert MacD. Jamison has been appointed chief engineer of the Novo Engine Co., Lansing, Mich. After graduating from Purdue University in 1930, Mr. Jamison joined the engineering staff of Kelvinator Corp., where he became Technical Assistant to the Director of Service. Later he returned to Purdue for post-graduate work, and received his M.E. degree in 1940. Since that time, he has been a member of the faculty of Wayne University at Detroit, Mich. At present he is Assistant Professor of Mechanical Engineering at that institution. He is now engaged in designing a complete new line of contractor's equipment for Novo.

▼

Maxon Opens Milwaukee Office

Glenway Maxon, Jr., mechanical engineer, has opened an office at 125 East Wells St., Milwaukee, Wis., where he will specialize in the design and research work on construction machinery. Mr. Maxon has had many years' experience in the construction industry.

Promotions by Timken

O. J. Horger, formerly in charge of railway engineering and research, has been appointed chief engineer of the Railway Division of The Timken Roller Bearing Co., Canton, O. C. L. Eastburg, who is in active charge of the design of bearings and parts as applied to locomotives, has been appointed assistant chief engineer of the Railway Division. P. C. Paterson, who has been active in the inspection and procurement of material and in equipment applications, will be service manager of the Railway Division.

▼

B. F. Miller Heads ARBA Contractors' Division

B. F. Miller

Burton F. Miller has been named managing director of the Highway Contractors' Division of the American Road Builders' Association, according to an announcement by James J. Skelly, president of the association, and Charles W. Smith, president of the division. Mr. Miller has been with the ARBA for nine years and since 1940, he has acted as an executive assistant to Charles M. Upham, engineer-director. His duties in this capacity gave him an intimate knowledge of the activities and objectives of the contractors' division.

A graduate of law and a member of the bar of the District of Columbia, Mr. Miller has been identified with the construction industry since 1933. Following a short period of private practice, he joined the Construction League of the United States, a federation of national associations in the construction field. His work with the league gave him a broad knowledge of the construction industry and the value of cooperative effort in association work. Throughout this period, he was actively engaged in liaison work before the Congress and government departments.

▼

New Koehring Distributor

Ray Dorward, R.R. No. 3, Trafalgar, Ind., has been appointed Koehring distributor for the new 205 ½ yard excavator in the state of Indiana, except for Lake, Porter, LaPorte, Starke, St. Joseph and Marshall Counties.

W. B. Sippey New Sales Manager Columbia Cement

W. B. Sippey has been appointed sales manager of the Columbia Cement Division of Pittsburgh Plate Glass Co., at Zanesville, O. Mr. Sippey started with the Pittsburgh Plate Glass Co. 28 years ago as a clerk in the company office and warehouse at Pittsburgh. He has been associated with the Columbia Cement Division for the past 19 years in the sales department, serving as assistant sales manager for four years prior to his present position. Chester R. Steenberg has been appointed assistant sales manager. He started with the Columbia Cement Division in 1928.

▼

Henry Lohse Co. Expands

Fred Stoddard

The Henry Lohse Co., Inc., 50 Roanoke Ave., Newark, N. J., distributors for International Harvester industrial tractors, tractractors, and allied equipment for Northern New Jersey, is expanding its sales and service facilities. Fred Stoddard, formerly district manager, Buffalo Branch of the Syracuse Supply Co., has joined the Lohse organization as general sales manager. He has had many years' experience in the industrial tractor and construction equipment field. Henry Lohse, designer of the Lohse industrial crane which has enjoyed popularity in the metropolitan area of New York, is now formulating plans to offer a national distribution of this machine through dealers in other territories. A separate sales and service organization will handle this operation of the business.

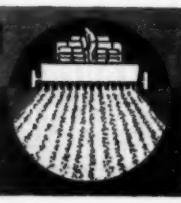
▼

Aeroil Changes Name

Aeroil Products Co. is the new name of the Aeroil Burner Co., West New York, N. Y., a leading manufacturer of oil-fired industrial equipment since 1917, and in recent years also in the gas-fired and electrically-heated equipment field. The new name avoids the apparent contradiction in the word "Burner" as applied to the many different types of electrical units now being produced by the company. Production will be continued on the line of "Heet-Master" kettles and No. 99 weed burners and maintenance torches, but added emphasis will be given to new types of equipment.

New La Plant-Choate Representatives

The following appointments have been announced by LaPlant-Choate Manufacturing Co. of Cedar Rapids, Ia., manufacturer of earth moving equipment: K. V. Turner, who has been with the company in various sales capacities for several years, has been named a district representative and placed in charge of the company's Washington, D. C., office. His territory includes parts of Virginia, West Virginia, Maryland, Pennsylvania, New Jersey and New York. A. C. Cartwright, formerly district representative in Mexico City, is now district representative for the southeastern territory with headquarters at Atlanta, Ga. Milo Davin, formerly central area service manager, has been placed in charge of the Central West territory as district representative with headquarters in Cedar Rapids, Ia. S. I. Harris, well known in the western states, resumes his old post as district representative for northern California and Nevada with headquarters at San Leandro, Cal., after two years as a major with the armed forces in India and China.



H. E. Snyder Joins Penn Metal Corp.

Lt. Col. Hubert E. Snyder, recently returned to inactive status in the Army, has been appointed vice-president of the Penn Metal Corporation of Penna., in charge of the Corrugated Metal Pipe Division, with headquarters in Philadelphia. While on active duty, Colonel Snyder served in the Control Division, Headquarters Second Service Command, Governors Island, New York. For twelve years previous to his call to active duty in the Army, Colonel Snyder was vice-president and general manager of the Shelt Co., of Elmira, New York, fabricators of corrugated metal pipe.

Lewis Rejoins Anchor Post Fence Co.

Commander A. Sidney Lewis, partner in Lewis and Company, Anchor Post Fence Co. representatives in Georgia, has been discharged from the Navy and resumed his former work with headquarters in Atlanta. Other Anchor Post Fence Co. representatives recently appointed are: C. A. Moorer, Jackson, Miss.; Jenkins Mantle & Brick Co., Amarillo, Tex.; P. C. Fitzpatrick Co., New Orleans, La.; and Globe-Van Doorn Co., Milwaukee, Wis.

Promote Ewell to Mack Southern Manager Post

Appointment of Elliott G. Ewell as vice president and manager of Mack's Southern Division has been announced by A. C. Fetzer, vice president of Mack-International Motor Truck Corp. Mr. Ewell, who has been with the firm since 1924, will make his headquarters at 730 Peachtree St. in Atlanta, Ga. Mr. Ewell joined the Mack organization 21 years ago as a salesman in the Charlotte, N. C. branch. He remained in the branch and in 1939 was named manager in Charlotte, which post he retained until his present appointment. His place in Charlotte will be taken by L. D. Marshburn who has been appointed branch manager.

▼

Mack Appoints Walker Chief Sales Engineer

John Walker has been appointed manager of the Sales Engineering Dept. of Mack-International Motor Truck Corp. Mr. Walker, who has had wide experience in applying special engineering principles to unusual transportation problems, will make his headquarters in Mack's executive offices in New York's Empire State Building. He joined Mack in 1918 as a member of the engineering department and two years later transferred to the Special Equipment Dept. In 1922 he was placed in charge of the department and in 1942 was named assistant to the chief engineer, which position he held until his present appointment.

▼

New Distributors for Gar Wood

General Machinery Co., Spokane, Wash., and Equipos Hobbs, S. A., Mexico City, have been appointed distributors for the products of the hoist and body and tank divisions of Gar Wood Industries, Inc., Detroit, Mich.

New Goodyear Export Appointments

R. D. Thompson has been named manager and Ivan B. Goble assistant manager of the Tire Department of the Goodyear Tire & Rubber Export Co., Akron, O. They will direct the overseas sales activities for all Goodyear tire products except bicycle and airplane tires.

▼

Berry Asphalt Moves Main Office

Berry Asphalt Co. has removed its main office to 120 South LaSalle St., Chicago, Ill.

Clearing House

ASPHALT TANKS

• 19—6,000 gal., 8,000 gal., and 10,000 gal. capacity heavy R.R. car tanks with heating coils.

Immediate shipment from Illinois—Louisiana—New Jersey

L. M. Stanhope Wayne, Pa.

TIRE REPAIRS

All sizes truck, tractor and 1800x24 tires. Our Equa-Flex repair is built for heavy and rough work.

It is guaranteed for six months, if the repair fails your money will be refunded.

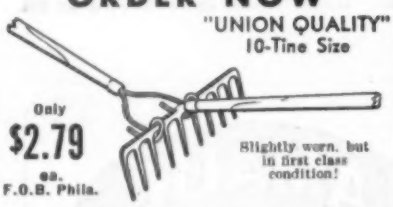
WALLACE TIRE SERVICE, Inc.
2329 S. Michigan Ave. Chicago 16, Ill.

UNUSUAL VALUE!

We suggest that ou

ORDER NOW

"UNION QUALITY"
10-Tine Size



Only **$2.79** ea. F.O.B. Phila.

Slightly worn, but in first class condition!

TWO-MAN RAKES

This is less than wholesale price for these heavy, reinforced rakes!
Only a limited quantity available.

Every contractor's need in stock; Pumps, Mixers, Generators, also a complete assortment of tools and supplies.

1744 Shannon & Co

J. JACOB SHANNON & CO.
Broad and Huntingdon Sts.
PHILADELPHIA 32, PENNA.

"The Oldest Equipment House in Philadelphia"

For Sale

One (1) Littleford 4200 gallon insulated distributor with Twenty-four (24) Foot bars. Can also be used as transport truck. Built in 1942.

With or without White Model 720 tractor.

GULF ASPHALT CORPORATION
900 MARITIME BLDG.
NEW ORLEANS (12), LA.
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FOR SALE

UNIVERSAL TOOLS!! { Pipe Wrench, Channellock Pliers, Adjustable Wrench, CLETEC Pliers, Diagonal Cutters, Hammer, Screwdriver, Vise-Grips, Hack-Saw, Cold Chisel } **$19.85 10 Pc. SET**

Mail Orders Shipped Promptly, Remit with Order
Catalogue Free with first order. Remember: We have it—can get it—or it isn't made!! Mail your order today.

DEALERS TOOL SUPPLY
1527 Grand Ave. R. S. Kansas City, Mo.

FOR SALE

Auto Patrol: 77 Austin Western, tandam drive, Diesel;
Gallon, tandem, International Gas Engine, starter;
#10 Caterpillar, tandem, Diesel;

Tractors: D7 and D8 Caterpillars with Scrapers;
D6, R4 LeTourneau Bulldozer with Hyster winch;
50 Caterpillar Hydraulic Bulldozer;
International 10-20 on rubber;

Shovels: 100 and 150 P & H;
105 Northwest Crane;
75A Lorain Shovel and Crane;
D2 and D4 Trackson High Lift;
Massey-Harris 4 wheel rubber tire Highway Tractor with sickle bar mower.

Trencher: 11 and 12 Buckeye;
95 Cleveland Baby and Cleveland Pioneer digs 10'.
25 Parsons.
10-30 P & H, Digs 13' deep, 35" wide.

Chas. M. Ingersoll Co.
19930 Detroit Road
Rocky River 16, Ohio

FOR SALE

1—160 h.p. Diesel Engine
1—110 cu. ft. Air Compressor
1—160 cu. ft. Air Compressor
Compressors mounted on trailers
1—Thew Steam Shovel and Crane with 1¼ yard rock bucket.

Stiers Bros. Construction Co.
2944 Magazine St. St. Louis 6, Mo.

FOR SALE—We have for sale the following used cast iron bell and spigot pipe.

Approximately 675' 8"
Approximately 1700' 12"
Approximately 240' 14"
Also 550' 8" steel pipe.

West End Iron and Metal Corp.
Wells, Michigan

TRANSITS and LEVELS

New or Rebuilt
Sale or Rent

Headquarters for REPAIRS—any make. Factory Service. We will also *buy* your old instruments or take them in *trade*.

A complete line of Engineering Instruments and Equipment for Field or Office. Write for Bulletin RS-16.

WARREN-KNIGHT CO.
Manufacturers of Sterling Transits and Levels
136 N. 12th St. Philadelphia 7, Penna.

FOR SALE

Late model CH-200 Brooks Load Lugger including two yard buckets. $600.00.
210 cu. ft. 2-stage Portable Sullivan Portable Compressor. Overhauled. $1200.00.
315 cu. ft. LeRoi 2-stage Portable Air Compressor. Overhauled. $1750.00.
Ingersoll-Rand, type D, late model Wagon Drills. X-71. Overhauled. Guaranteed. $750.00.
15" x 38" Tellsmith-Wheeling R. B. Jaw Crusher. A1. $3500.00.
M. Wenzel, 2136 Jefferson Street, Kansas City, Mo.

WANTED: Superintendent to assist in the erection of and to later operate new Readi-Mix Concrete plant. Frederick G. Smith & Co., 327 E. Stephenson St., Freeport, Ill.

WANTED: Foreman for lumber, coal, and building material yard to supervise workmen, trucks, and loading of material. Frederick G. Smith & Co., 327 E. Stephenson St., Freeport, Ill.

FOR SALE

1—Ord Finishing Machine—20'-22'
1—Ord Finishing Machine—10'
1—42" Austin Elevating Grader with Power Take-Off
1—Adams 12 ft. Leaning Wheel Blade Grader
1—Austin Hydraulic 12-Yd. Scraper
1—80 H. P. Cletrac (Crawler)—Gas
1—24 ft. House Trailer

Chicago Heights Coal Co.
27 East Nineteenth Place
Chicago Heights, Illinois

DON'T OVERLOOK THIS!

For Sale: One Rex 34E Duomatic Paver—Complete with 6 cylinder gasoline engine, Rex mechanical man, 35 Ft. distributing boom and bucket, etc. Recently overhauled. Excellent Buy!

FUCHS MACHINERY & SUPPLY CO. Jackson at Fifteenth St. Omaha, Nebraska
Headquarters for Construction and Earth Moving Equipment New and Used

Index to Advertisers

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ALL-GREEN WIRE ROPE IS TRU·LAY PREFORMED I.P.S.*

EXCLUSIVE NEW GREEN LUBRICANT LENGTHENS LIFE OF THIS SUPERIOR ROPE

THE WORLD'S BEST ROPE MADE STILL BETTER

● Hundreds of field tests, confirmed by scores of laboratory tests, prove this new green lubricant has greater adherence with the result that the wires it covers wear longer, give increased service. So now, every strand of **TRU·LAY** Preformed made of Improved Plow Steel* is literally "stuffed" with this superior lubricant.

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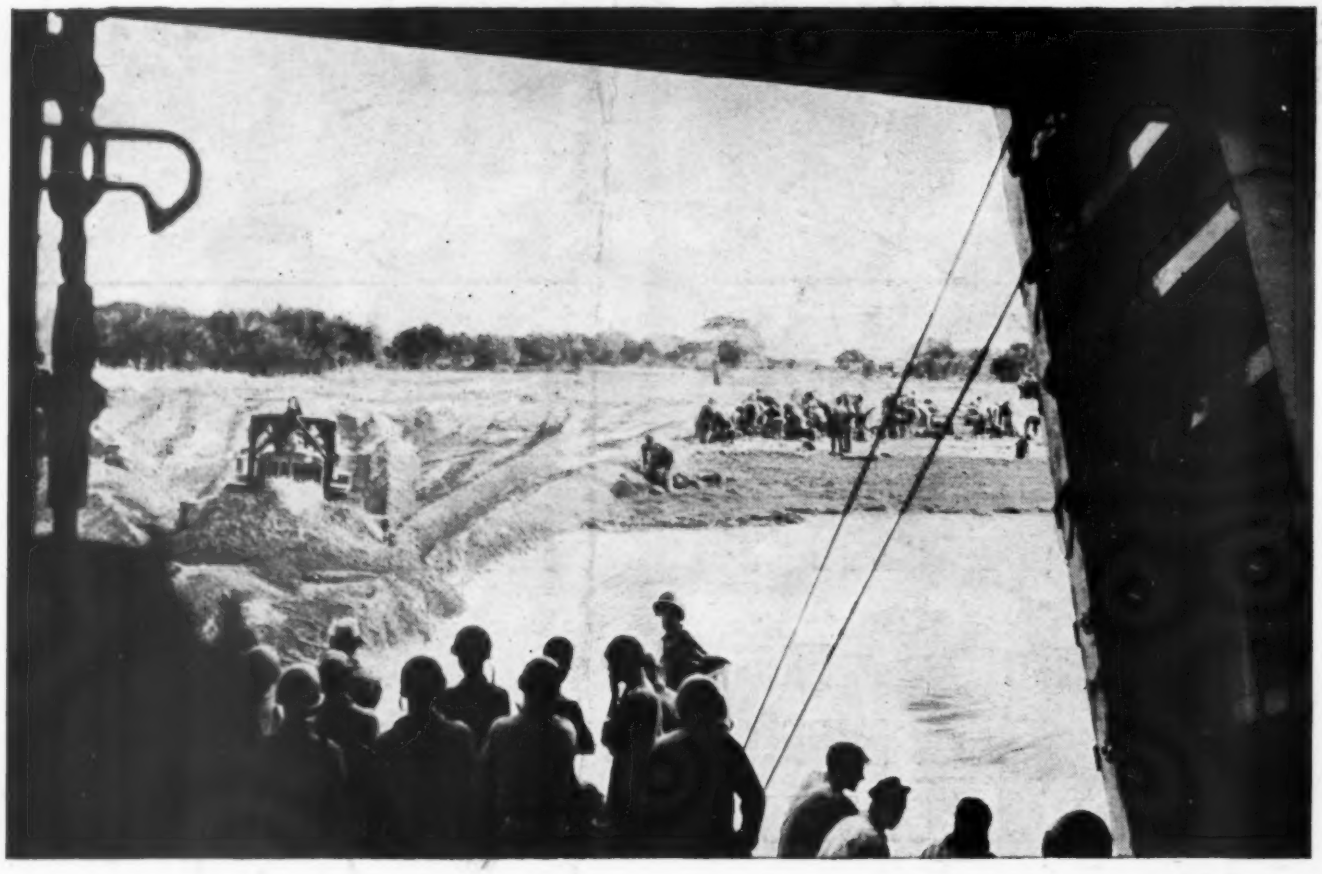

Getting the Most Out of a Bulldozer

CARVING airstrips out of jungles and dozens of equally difficult assignments have proved how expert the Seabees are in getting the most out of a bulldozer. Here, on an "easy" job, one of them builds a causeway to enable the crew of an LST to unload supplies.

On a Pacific island or here at home, getting the most out of bulldozers—and other types of construction equipment—depends not only on the operator's skill but also on effective lubrication. Maintenance-wise contractors everywhere know effective lubrication is always assured when they use Texaco.

Texaco Ursa Oil X★★ for Diesels and heavy-duty gasoline engines, for example, assures better compression and combustion, greater fuel economy and more power because special additives give this heavy-duty oil the valuable properties of detergency and dispersion. Its detergency keeps piston rings free and engine parts clean. Its dispersive ability holds deposit-forming materials in suspension until drained. *Ursa Oil X*★★ resists oxidation, protects alloy bearings and prevents scuffing of rings, pistons, cylinders.

For quieter-running, longer-lasting transmission and differential gears, use Texaco transmission and differential lubricants.

Texaco lubricants have proved so effective in service they are definitely preferred in many fields, a few of which are listed at the right.

Texaco Lubrication Engineering Service is available through more than 2300 Texaco distributing plants in the 48 States. Get in touch with the nearest one, or write:

The Texas Company, 135 East 42nd Street, New York 17, N. Y.

THEY PREFER TEXACO

★ More locomotives and railroad cars in the U. S. are lubricated with Texaco than with any other brand.

★ More revenue airline miles in the U. S. are flown with Texaco than with any other brand.

★ More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.

★ More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.

★ More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.

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TEXACO Lubricants and Fuels

FOR ALL CONTRACTORS' EQUIPMENT

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